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NEW NORTH GERMAN LLOYD EXPRESS STEAMSHIP KAISER WILHELM II.

The magnificent new ship *Kaiser Wilhelm II.*, of the North German Lloyd Steamship Company, has made her first appearance in New York harbor, and has created much interest because of her immense size and exceedingly elaborate passenger accommodations.

Evidently the builders have not in any way been limited as to the cost of the ship, for she is the most thoroughly and expensively fitted out vessel to be seen in the passenger service. This is in evidence from stem to stern. In general appearance she resembles the *Deutschland* and the *Kronprinz Wilhelm*, the most recent big ships up to date built in the German yards. It was the intention of the owners to secure in this new ship a vessel of very great speed, by which she was to snatch the record from the *Deutschland*, of the Hamburg-American Line, and, at the same time, to have a vessel that was the most elaborately equipped in the world.

Following these lines, one would not expect to see much space devoted to carrying cargo; in fact, there are but two cargo hatches, one forward and one aft, at the break of the deck houses. Under the forecastle deck is placed a vertical engine for operating three capstan hoists driven by gearing and shafting to the forecastle deck. The windlass engine is on the deck below and drives two vertical drums round which the chain is passed. The ventilators in this exposed part of the ship have welded steel plate hoods which are of the same size as the body of the ventilator and have cast-iron covers.

NEW EXPRESS STEAMSHIP KAISER WILHELM II. LEAVING BREMERHAVEN.

The lay-out of the first-class passenger accommodations is most extensive, and the numerous passages, decks, and saloons are quite confusing. The names of the seven decks of the ship are as follows: Orlop, lower, main, upper, spar, promenade, and upper promenade. The ship can accommodate 775 first-class passengers, 343 second-class, and 770 third-class passengers. Add-

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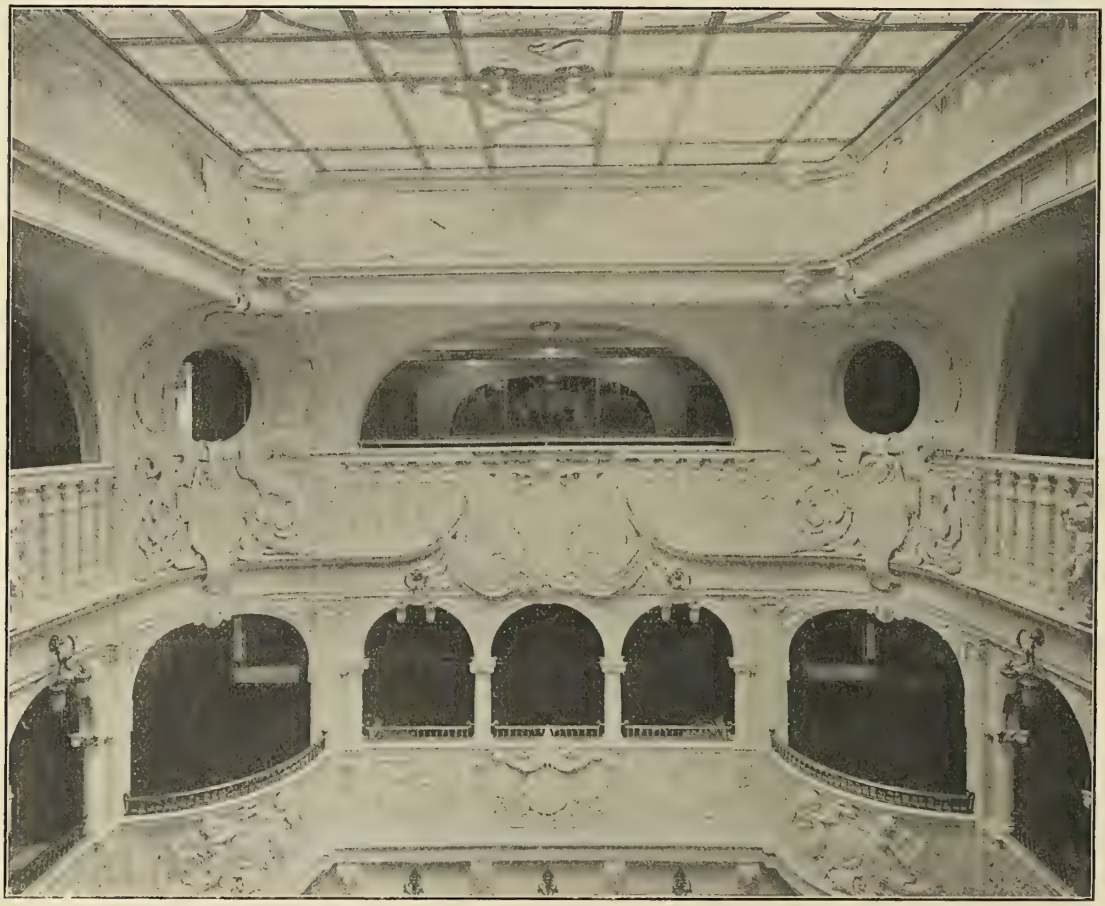
ing to this the complement of a crew of 600 men, including officers, the total number to be cared for will be about 2,500. Included in the first-class cabins are two so-called Imperial suites, 8 apartments de luxe, and 12 state cabins. In addition there are 290 cabins for the first-class passengers and 107 for the second-class. On the upper-promenade deck, at the forward end of the house, is a very beautiful writing room or library, furnished in red draperies, the panels and wainscoting being decorated with fine lacquer work. On either side of the ship, aft of this, are the Imperial suites, comprising bed rooms, parlor, breakfast room, and bath.



BALCONIES AROUND DINING SALOON LIGHT WELL, STEAMSHIP KAISER WILHELM II.

fitted up in a most luxurious and elegant manner. Each suite is decorated in colors of its own and has electric heaters, folding beds, brass bedsteads, or lounges. The woodwork throughout is a very fine finish, some suites being in mahogany, others in maple, oak, etc. The panels are chiefly of silk tapestry. Clothes presses are built in each room. The private bath rooms are all large-sized rooms and many of them are equipped with tinned tubs. The very latest sanitary plumbing is installed throughout.

Forward of the main stairway and vestibule is the drawing room, beautifully decorated and with light silk draperies. The principal feature is a large painting of the German emperor; other paintings decorate the walls. In the center of the room is a beautiful large skylight and below it is the glazed dome to the light well for the dining saloon. From the vestibule on either side of the ship, corridors lead aft, finished in ashwood and grayish blue. Leading off these passages are many suites of well-appointed rooms. The starboard passage opens into the smoking room, richly decorated in the Renaissance style, which to many is the finest piece of work on board the ship. The floor is laid in green and black rubber tiling and the finishings and furniture are of leather embossed in gold and olive. A beautiful dome supplies abundant light through opaque crystal with green trimmings. The wainscoting of the room is polished mahogany, gold trimmed, and is as fine a specimen of carved work as can be seen afloat. Above a large open fireplace is a painting surmounted by a statuette of Germania. The passageway from the after end of the smoking room leads between the engine casing to other state rooms and also to a stairway to the two Vienna cafés, brilliantly lighted rooms finished in yellow, gold, and olive. One is for the use of smokers and the other for non-smokers.

Descending two flights of stairs we turn to corridors leading to the first cabins, and at the forward end is the main staircase and entrance hall. A very beautiful effect is secured at this point by balconies which open on the four sides of the light well, both on this deck and on the one below. At the forward end of the bal-

cony is the children's saloon, and directly below it is the purser's headquarters, or, as has been termed on the *Kronprinz Wilhelm,* the "office." Here are the letter boxes for each room, a telephone central station, connections being made to the telephones in all the cabins, a safe for the deposit of passengers' valuables, and, in fact, this is the "bureau of information."

Lavatories, bath rooms, etc., are abundantly provided at suitable points and the equipment is the very highest class of plumbing. The corridors lead forward to other first-cabin accommodations. Descending one more flight we come to the dining room, which is on the main deck and extends from side to side of the ship. Three long tables, fore and aft, will seat about 200 people, and short thwartship tables extend to the sides. The full seating capacity is 554. The decoration is very elegant, although strikingly simple in comparison with German ships of ten and fifteen years ago. It has evidently been the intention of the designer to have the rooms light and airy and in no way oppressive in design. Oil-painted panels of land and marine subjects adorn the walls, and silk tapestry is also used extensively. Because of the large light well, which rises through three decks, and the numerous side lights, this room is well lighted in the daytime, while at night the illumination is no less brilliant by the use of hundreds of electric lights set in the ceilings. This may be considered to be the finest dining saloon of any of the great German ships. The pantries are immediately adjoining the after end of the dining room and a stairway leads to passenger accommodations on the decks below.

The second cabin, placed at the after end of the ship and following the usual plan of the North German Lloyd, is very handsomely finished. There is a ladies' room and a smoking room on promenade deck and large dining saloon on main deck.

Nothing has yet been mentioned of the splendid deck space provided on these ships; on the upper, promenade, and the upper-promenade decks there is a space the entire length of the bridge house, over 500 feet long and about 15 feet broad. On all of these decks the light to the rooms within is admitted through large rectangular ports and a small ventilator above, the type which is generally used on all large passenger ships; the upper ventilator is adjusted by a screw to any position desired.

DRAWING ROOM, STEAMSHIP KAISER WILHELM II.

It is on these decks that one may judge of the fine workmanship of the Stettin yard. The ironwork is a sight which would make envious any superintendent. The riveting, done by pneumatic tools, is a clean piece of work throughout. There are no evidences of expansion joints in the decks or sides of the structure. An after deck house is provided for the second cabin, and a special house aft of this is used for the reserve.

Brown steam steering gear. This gear is attached to the rudder stock, but is only used in case of emergency, the main gear being located below decks and below the water line. Either gear may be operated by telemotors from the bridge or after wheel house. Above the upper-promenade deck, at the forward end, are placed the captain's drawing room and bed room, and above this are the main bridge, a steel chart room, and screen; here are placed the officers' telegraph system, binnacles, steering gear, etc. At this point, also, is the mechanism for operating the water-tight bulkhead doors placed throughout the ship below the water line. This system

FIRST-CABIN DINING SALOON, STEAMSHIP KAISER WILHELM II.

is the same as that installed on the *Kronprinz Wilhelm*, and is known as the Dörr system, the patents for which have recently been secured by the North German Lloyd Company.

Passing to the engine room one finds an unusual arrangement of machinery; in fact, the *Kaiser Wilhelm II.* is the first merchant ship to be fitted out with four complete sets of engines. There are two four-cylinder, three-crank, quadruple-expansion engines attached to each shaft. These were described and illustrated in the November number of Marine Engineering, and the diameters are given in the accompanying table. The high-pressure cylinders of the two engines on one shaft adjoin each other, but are separated by a water-tight bulkhead which extends above the top line of cylinders. The high-pressure cylinders are mounted on top of the first intermediate; the second intermediate valve chest adjoins the first intermediate cylinder; and next in order comes the second intermediate, then the low-pressure valve, and the low-pressure cylinder. The valves are operated by a Stephenson link motion and are all of the piston type, except that on the low-pressure cylinder, which is a double slide valve. The motion for the high-pressure valve, which is at the side of the cylinder, is carried by a rock shaft from the first intermediate valve stem. There is one main steam pipe to each pair of engines, leading to the valve chest of the forward sets, from whence it is piped with an expansion joint to the valves of the after sets. The cylinders are cast iron, mounted on cast-steel columns front and back. These columns are very beautiful castings; the outsides are smoothed up and painted to a fine polished surface; the bed plates are also cast steel. A very elaborate system of oiling is fitted and oil is introduced into all the stuffing boxes. The connecting rods are rather short and the shafting for each engine is in two sections, one for the low-pressure cylinder and its slide valve and one for the other two cranks. There are two journals for each crank, with wrought-steel slabs. The large half of each eccentric is of cast steel and the other of cast iron. Ordinarily the working platform for both engines is opposite the high-pressure of the forward engine, but each

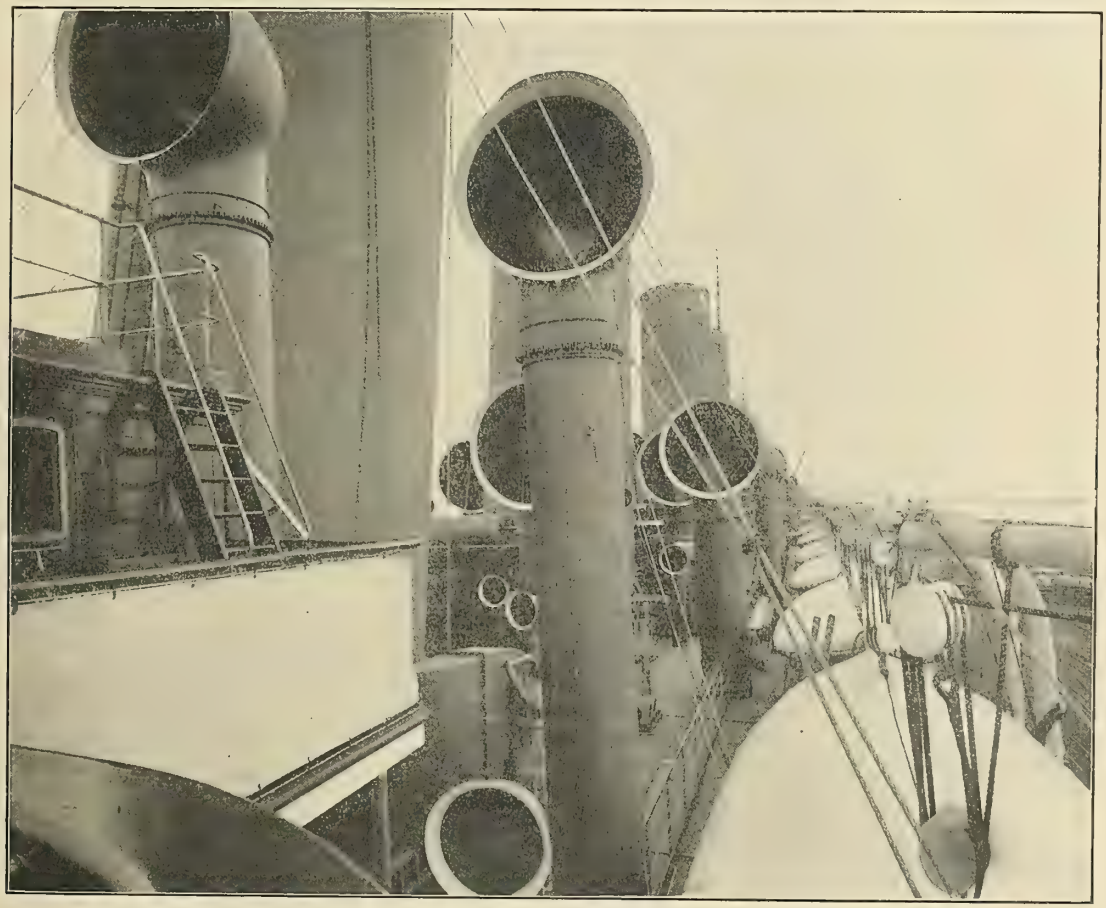
engine may be controlled from its own compartment, or both may be operated from the after engine room; in case it is necessary to uncouple the engines this may be done by removing the coupling bolts of the crank shaft between the engines and by uncoupling the reversing shaft. Each engine has a Brown reverser on the back of the first intermediate-pressure cylinder. Also in each engine room are installed an independent condenser and a double-cylinder Weir air pump. Weir feed pumps are also installed, and one pump of this make is used for lifting the water from the hot well to the heater. Aft the thrust bearings, which are of the horse-shoe type, each one being fitted with thirteen collars, is placed the dynamo room, which in truth is a division of the shaft alley. Between the shafts four direct-connected Union Electricity Company's compound generating sets are placed, for supplying current to 2,700 25-candle-power lights, and aft of these are two carbon anhydride refrigerating machines, each mounted on its condenser. The main switchboards are placed above the dynamos and lead to the distributing switchboard placed on the top platform of engine room.

On the recent trip an approximation was derived of the effective horse power of the starboard engine by placing an apparatus on the line shaft which measured torque or twist of the shaft between two points about three feet distant from each other longitudinally. The device is evidently a result of the experiments recently carried on by the North German Lloyd to ascertain the twist of propeller shafts, yet the variation in quality of material seems to indicate that this method is not reliable and can only be used on a comparative basis for one shaft.

In each engine room is a high-duty fire pump, and in this compartment may be seen the details of the Dörr system of operating bulkhead doors above mentioned; hand gearing is also provided for all doors.

Passing forward through a long tunnel in the coal bunkers one enters the boiler room, the arrangement of which is: At the after end are three single-end four-furnace boilers and at the forward end are three double-end eight-furnace boilers. A stokehole next forward is used for firing the opposite ends of these double-end boilers and three other double-end ones, and from another stokehole the forward ends of latter-named boilers are fired. The thwartship coal bunkers separate the boilers just mentioned from the forward battery, namely, six double-end and four single-end. In each stokehole is an ash ejector, operated by a powerful pump placed in a bunker recess. Side bunkers extend the full length of the boiler rooms, and there is also placed in each compartment a ballast pump. Natural draft is used and there are four stacks.

The high class of steel work and fittings is shown as



STEAMSHIP KAISER WILHELM II., LOOKING AFT FROM THE BRIDGE.

much down below as above decks. The riveting is very neat and the plates are cut straight; thus in the bulkhead stiffeners the heel of the angle on almost any stiffener lies perfectly flush with the edge of the plate. In the engine room the structural work looks like some special job. One is forced to believe that this is the character of work turned out by the great yard at Stettin, for it would be practically impossible to do both this kind and a second grade of work. While this high class of work may be no stronger than the other class, it is certainly more satisfactory, and, when once adopted, would be found no more expensive; in fact, so-called "cheap" work is probably the most expensive.

As is stated at the beginning of these remarks, the *Kaiser Wilhelm II.* may be looked upon as the finest production of the shipbuilding yards, and in her has been reached the greatest triumph of the ocean.

NAME—Kaiser Wilhelm II. NATIONALITY—German. TYPE—Ocean express steamer.
LAUNCHED—August 12, 1902. BUILDER—Vulcan Shipyard. OWNER—North German Lloyd.

Length over all	706 ft. 6 ins.	Height of engines over all	43 ft. 4 ins.
Beam	72 " 0 "	I. H. P., designed	40,000
Depth to upper-promenade deck	72 " 7 "	Revolutions	80
" of water bottom	7 " 0 "	Speed	23 1-2 knots
Draft, load	29 " 6 "	Condensers, cooling surf. each	11,732 sq. ft.
Displacement, launching	11,200 tons	Propellers, diameter	22 ft. 10 ins.
" load	26,500 "	**Shafting**, length, total	230 ft.
Coal bunker capacity	5,700 "	Weight, total	65,000 lbs.
Water ballast	2,097 "	Diameter, forward crank	20.87 ins.
Fresh water	1,068 "	" after	25 "
Engines..4 sets, quadruple, twin screws		" propeller shafting	25.4 "
Cylinder dia...37.4.49.2.74.8.112.2 ins.		**Boilers**.....12 double-end, 7 single end	
Stroke	70.8 "	Pressure	213 lbs.
Length of two engines	92 ft. 0 "	H. S., total	107,000 sq. ft.
		G. S., "	3,121 "
		Length, boilers	ms & coal bkrs., 295 "

Construction for Boston Navy Yard.—Official notice has been sent to the commandant of the Charlestown (Boston) Navy Yard that one of the two steel training ships authorized by the last Congress will be built at that yard. The ship will cost about $337,000 outside of her armament.

Monthly Shipbuilding Returns.—The Bureau of Navigation reports 135 vessels of 44,619 gross tons built in the United States and officially numbered during the month of April, 1903.

GRADUAL COLLAPSES OF FURNACE CROWNS: A SUGGESTED EXPLANATION.*

BY H. M. ROUNTHWAITE, ESQ.

When a furnace crown is under usual working conditions, the side exposed to the fire will be hotter than the side in contact with the water, and this difference of temperature will depend upon the intensity of the combustion, the pressure of steam carried, the condition of the surfaces as regards soot, scale, grease, etc., and also to a slight extent upon the thickness of the plate.

Also, the hottest part of a furnace crown is probably that adjacent to the longitudinal center line, since that part is placed normally to the direction in which most of the radiant heat leaves the fire, and is also worse off as regards water supply than other parts. The water supply to the central portion of the crown must come mainly from the sides, and must, therefore, contain a considerable proportion of steam bubbles which have not had time to rise clear of the plate lower down the curve of the crown; and, as the currents from the two sides meet and change direction near the center line, an eddy is formed, and the water close down on the center of the plate tends to be somewhat stagnant, and so to contain a greater proportion of steam bubbles than the water elsewhere, and, therefore, to have also a higher mean temperature.

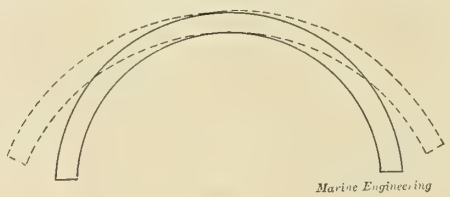


FIG. 1.

Let it be granted, then, that the fire side of the plate is hotter than the water side, and that the temperature is a shade higher near the center line than elsewhere.

If the crown plate were a free strip of metal, as indicated by Fig. 1, this distribution of heat would cause it to change its form from that shown by the full lines to such a one as is indicated by the dotted lines, owing to the greater expansion of the layers on the fire side. The furnace tube does not consist of such free strips of metal, but it is well known that some action of this kind does take place, and that, in spite of the restraining forces, or resistances, the furnace tube does assume a more or less oval form in cross section, the sides going out and the crown and bottom plate approaching one another.

But the resistances prevent the sides moving out to anything like the distance due to the difference in the expansion of the two faces of the plate, and the result is that the inner layers are crushed up to some extent, the outer ones being at the same time possibly stretched to some minute extent, but the marked effect is the crushing.

As another example of a similar action, the case of a hot bearing brass may be referred to in passing. The heated inner layer cannot at once expand, because of the restraint due to the cooler outer layers, and it is crushed

*Read at the Spring Meeting of the Forty-fourth Session of the Institution of Naval Architects, April 1, 1903.

in consequence; and when cool again, it shows minute cracks, which are caused by the action of the shaft pressure in restoring the inner layer to its original length.

Assuming now that the layers next the fire have been more or less crushed in this way, suppose further that the fire door is opened (for the purpose of firing or of cleaning the fire), or that the ashpit damper is closed, or the fire banked, and that the furnace temperature falls in consequence. Then, if the crown plate were free, it would tend to return to its original form as the temperature fell, but, owing to the crushed and shortened inner layers, it would go further and become an oval with the longer diameter vertical if it were allowed to become quite cool again. But the crown plate is restrained, not free, and it probably does not even return quite to its original semi-cylindrical form when cooled, because the exposure to heat has been long, and some molecular readjustment will have taken place, whilst the frequent periods of cooling are short. Thus, the crushed layers on the fire side are trying to pull in the sides of the furnace and the resistances are preventing more than a partial readjustment of form, with the result that the crushed layers are now subjected to stretching or

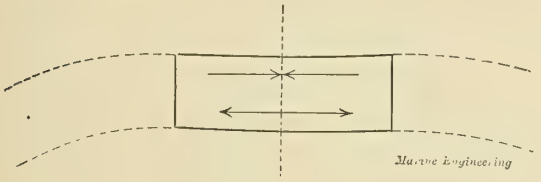


FIG. 2.

are in a state of tensile stress. But this tensile stress in the layers next the fire sets up a corresponding compressive stress in the layers next the water, and this stress is always tending to crumple them up or crush them together. The important point is that, although these stresses are not sufficiently great to produce immediately a perceptible effect, the same series of actions and reactions is gone through dozens of times in every day during which the boiler is under steam, the furnace tube "breathing" with every change of temperature, *and their effect is cumulative.*

An exactly parallel case, which will serve as a very good illustration, is that of the continued shrinkage of an iron ring when alternately heated to redness and quenched in cold water. The outer layers are suddenly caused to contract, and, in so doing, they crush the inner portions which are still in a hot condition; and this effect may be reproduced a number of times, the ring increasing in cross section and diminishing in diameter with each repetition.

Now, if stresses as above described act in every element of the furnace crown (their disposition being that indicated on this page in Fig. 2), their general tendency is evidently to straighten the curvature and eventually to produce a minute flat at some point—that point being determined as is the point at which contraction of area takes place in a tensile test piece, viz., by some defect or weakness too slight to be observable. And in the case of the furnace crown, the minute flat will evidently tend to appear at the hottest point in the circumference —the top.

Let the full line in Fig. 3 represent such a flat after the cumulative effect of the forces has made it quite perceptible, but drawn, for clearness, in an exaggerated manner. Then it appears that, as regards any compressive stress that may now come upon the inner layers, there are two weak points at the angles *A, A,* and the crushing effect of such a stress would be localized at these points, with the result that the section would tend to gradually take the form indicated by the dotted lines, *i.e.,* the shoulders would hunch up and the center part go down, thus gradually producing a pocket in the crown plate.

The explanation of the fact, so often observed, that such a pocket will come down so far and then stop may be that, when it attains a certain depth, it acts as an expansion joint, and allows the furnace tube to "breathe" as much as the changes of temperature compel it to. That when set back such a pocket tends to form again in precisely the same position is exactly what might be expected when the material is injured, quite imperceptibly no doubt, but still fully enough to again determine, or localize, the effect of the continually acting stresses.

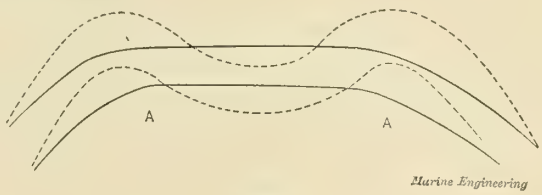


FIG. 3.

As to the effects of grease, scale, etc., although these would hasten and intensify the action in question, it is clear that they are only accessory or subordinate causes, the primary cause being simply change of temperature.

It would also follow, if this is the real cause of these gradual collapses, that they will be less frequent in boilers fitted with mechanical stokers, other things being equal, and it would be interesting to know whether any such difference has been observed.

Further, it would follow that stiffened and corrugated furnaces will be more liable to collapse than those which can change form, or "breathe" more freely, since it is the *resistance* to breathing that causes the trouble. A plain furnace of rather thicker plate should have the advantage over those of more rigid type, as the depth of girder (*i.e.,* the difference between the outside and inside radii) is less in the former than in the latter. Also, the short and rigid furnaces of marine boilers will suffer more from these collapses than the longer and less rigidly held furnaces of Lancashire boilers. And the cure lies evidently in such manipulation of the furnace when at work, or alterations in its construction, or in such additional appliances, as will reduce, or entirely prevent, changes of temperature.

Work on the Battleships.—60,000 pounds of steel a day are being built in the two battleships *Rhode Island* and *New Jersey,* under construction at the Fore River shipyard. Backing for the forward turret barbette is being set up.

Light-Draft River Ice Breaker.

One of the most excellent light-draft ice breakers for small river service is the *Schwarzwasser,* built at the yard of T. W. Klawitter, Danzig, Germany. She is 125 feet long between perpendiculars, 119 feet 5 inches long on the water line, 20 feet molded beam, and 10 feet 8 3-4 inches deep. The *Schwarzwasser* is a twin-screw steel vessel with flat bottom, cut-away stern, and very full lines in the fore body, so as to make her able to run high on the top of the ice, breaking the same through her weight, and for that purpose the boiler is located well forward. In the middle of the vessel, over engine, boiler, and cabins, the deck is raised to about 2 feet 4 inches, to obtain the necessary head room.

The complement of officers and men consists of master, engineer, two firemen, cook, and five deckhands. In summer-time the vessel will be used for inspection service, and has for that purpose a state room and a saloon for government officers. The vessel is well adapted to the service, except that at times the change in trim when breaking the ice lowers the water on the crown sheets of the long locomotive type of boiler. A shorter boiler would be preferable.

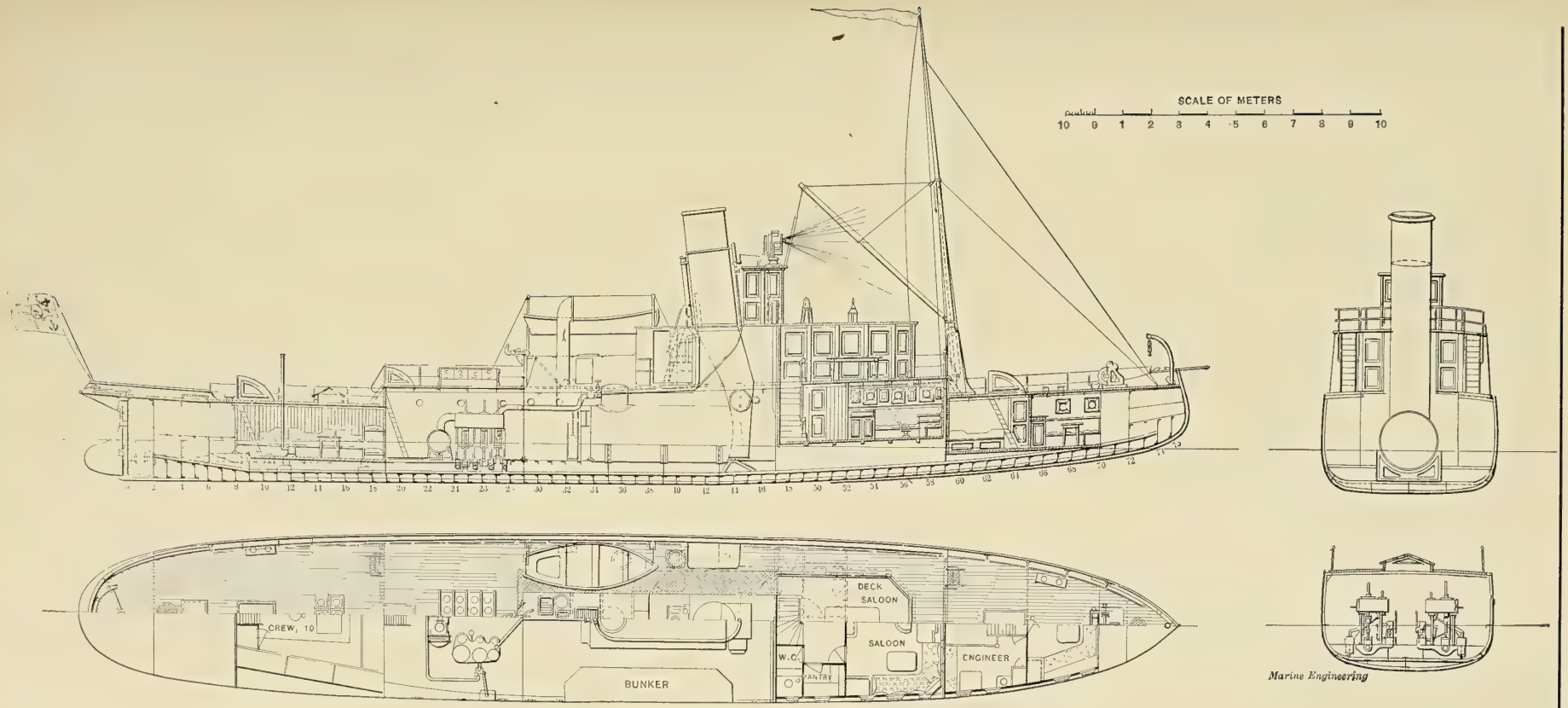
Seven water-tight bulkheads divide the vessel into eight compartments. Between the stem and frame 8 is the store room; the accommodations for firemen, cook, and deckhands are located between frames 8 and 19; the engine room, with the two engines and the dynamo, is in the next space; the boiler, with the wing bunkers for 32 tons of coal, occupies the fourth compartment from frame 29 to 47. In the space between frames 47 and 59 are, on port side, the state room for the government officer, and, on starboard, the pantry, watercloset, and hallway, with the stairs from the main deck; the steps are of oak, the standards and the rail of mahogany. Then follows the saloon, which occupies the full width of the vessel. A writing desk is placed at the front end in the middle of the saloon, while on the after ends on port and starboard two sideboards are arranged. Two tables, one stool, and a small sideboard with mirror complete the outfit. The floor is covered with linoleum. The saloon receives the necessary light from three side lights of 10 inches clear in diameter placed in the shell, and five side lights of the same size arranged in the front bulkhead of the raised deck. This saloon is finished in oak with maple panels. In the sixth compartment of the vessel, extending from frame 59 to 64, are the cabins for the master and engineer, well equipped; their mess room, from frame 65 to 70, occupies the full width of the vessel. The entrance to these accommodations is from a companionway on deck. The mess room is fitted with sideboards on the after end, with two long leather-cushioned seats, and two 10-inch side lights on each side. The space between the bulkheads 70 and 72 is provided for chain locker, while the eighth part is used for store room.

A small hatch, 33 inches by 25 inches, is arranged in the deck over the store room aft. The companionway and skylight over the crew's cabin are built of teak. Two iron steps with stairs of checkered plates lead to the raised deck. The entrance to the engine room is at the after end of the engine house through a teak companionway; skylight over the engines is of the same material. The engine house is built of 5-32-inch plates, the top being fitted with four fidley hatches with hinged covers. Arrangement for towing is made on the after end of this house. The galley is on deck in the boiler house. Two small side houses are built on each side of the bulwarks, extending from frame 40 1-2 to frame 44 1-2, the tops of which are formed by the saloon deck, which extends for the house's length over the whole width of the vessel. A small boat is hung on davits on the port side near the engine house. The deck over the boiler is built on both sides, between boiler house and bunker walls, of checkered plates. Deck beams are cut at the bunker walls, so that the boiler may be taken out of the vessel without removing the deck planks. The deck saloon in front of the boiler house is finished in oak and is used for smoking room by the officers. On the saloon deck is the pilot house with the steering gear. A searchlight is arranged on the roof of the house.

The material for hull is Siemens-Martin steel. The rudder post is a forging 5 1-2 by 2 inches, rudder stock 4 3-4 inches in diameter with 3 1-8-inch pintles; the rudder plates are 3-16 inch thick, and the rudder frame is filled in with wood. The stem is constructed in its upper part as an angle bar 4 by 4 by 3-4 inch thick, but in and under the water line it is flattened out into a shoe.

The frames are 3 by 2 1-2 by 9-32 inch, spaced 19 3-4 inches centers. There are two cant frames on each side of the vessel. All rivet holes for the longitudinal laps of the shell plating are drilled after fitting up the plates. The heel bitts are of the same scantling as the frames, 2 feet 8 inches in length, having three rivet holes on each side of the center keelson for riveting the frames together. The reverse frames are 2 1-8 by 2 1-8 by 1-4 inch angle bar, extending from the center keelson to 4 inches above the side stringer. The straps are 18 inches long and scored through the keelson, riveted with 2 rivets on each side of the keelson to the reverse frames and floor plates. The floor plates are 11 inches high and 9-32 inch thick, reduced to 1-4 inch at ends, except in the engine and boiler room, where they are 5-16 inch thick. All floors are connected by double angles with the center keelson.

The collision bulkhead is 1-4 inch thick; all other bulkheads are built of 3-16-inch plates for the lower parts and 5-32-inch plates for the upper parts. All bulkheads are fitted to deck with double angle bars 3 by 3 by 1-4 inch, and to sides with double frames, both edges of which are planed and calked water-tight. The bulkhead stiffeners consist of angle bars 2 1-2 by 2 1-2 by 1-4 inch, laid on one side vertically, 24 inch centers, while two angles are arranged horizontally on the other sides, except the bulkheads under the raised deck having three horizontal stiffeners. All stiffeners of the collision bulkhead are connected with knee plates to the shell and the deck. The bulkheads are tested by hydrostatic pressure corresponding to a head of water 12 feet from the bottom of the vessel. The deck beams are arranged on alternate frames and consist of angle bar 5 by 3 by 11-32 inch, and connected to the frames by 5-16-inch brackets. The camber is 5 inches.



ICE BREAKER FOR RIVER SERVICE, BUILT AT DANZIG, GERMANY.

The keelsons consist of center keelson, side and bilge keelsons. The center keelson is of 5-16-inch plates, connected with the keel plate by two angles 3 1-2 by 2 1-2 by 5-16 inch, reduced at the ends to 9-32 inch. The rider plate is 9 inches wide by 11-32 inch thick and the upper bars are of same size as lower ones given above. The butts of the center keelson are treble riveted with double butt straps of two-thirds of the thickness of the plates they connect. The side and bilge keelsons are made up of double angles, 3 1-2 by 2 1-2 by 5-16 inch, with intercostal 9-32-inch plates attached to shell by single 2 1-2 by 2 1-2 by 1-4-inch clips.

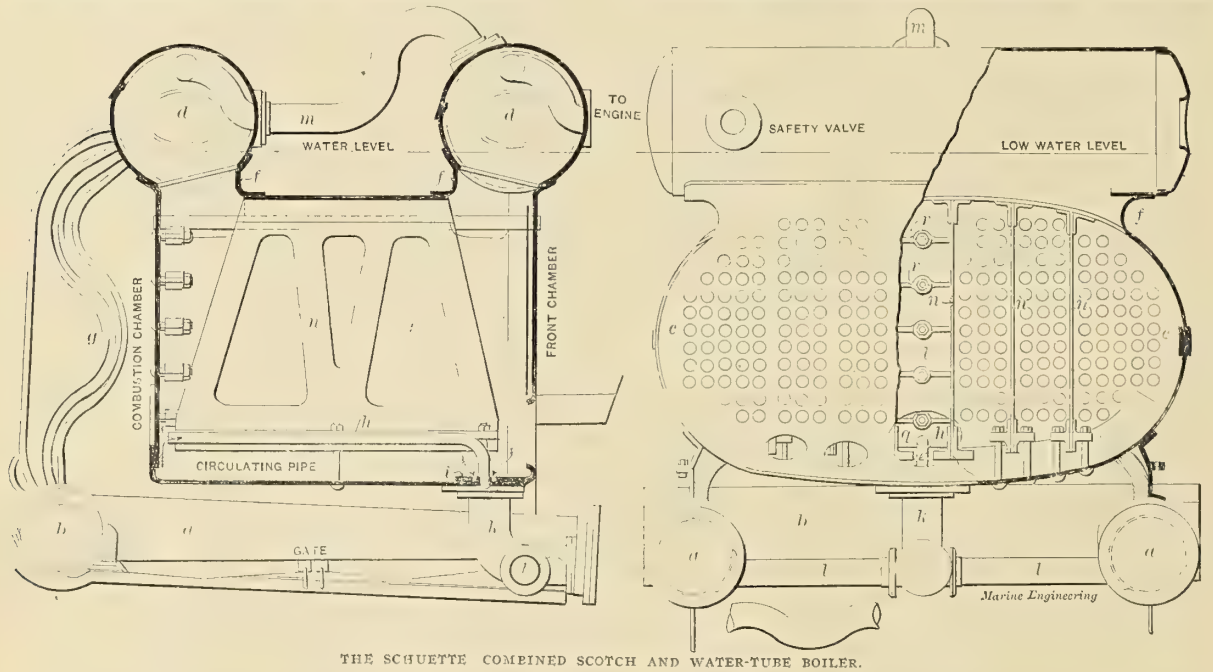
At the load-water line a side stringer 12 inches wide is built of 5-16-inch plates. The deck stringer bars are 2 3-4 by 2 3-4 by 9-32 inch. One angle of the same size is arranged on the inner under edge of the plate and 9-32-inch knee plates are riveted on alternate frames to the stringer and frames. The deck-stringer plate is 24 inches wide by 5-16 inch thick.

The 6-inch waterway is bordered on the outside of the sheer plank by the gutter bar, 2 1-4 inches by 2 1-4 inches by 1-4 inch thick. Deck planks are of white pine 4 inches by 2 3-4 inches. The sheer plank on the gutter bar and margin plank on the deck openings are of oak. All deck planks are fastened by means of 5-8-inch galvanized bolts. Tie plates, 8 by 5-16 inch, are run at all deck openings.

The keel plate is 20 inches by 1-2 inch amidships, reduced in the after body to 7-16 inch, while it is increased forward to 19-32 inch. The bottom and bilge plates are 15-32 inch amidships, decreased in the after body to 13-32 inch, but increased in the fore body to 9-16 inch. The thickness of the side plating is, beginning at the stem, for the first fourth of the vessel's length 9-16 inch, reduced for the next two-fourths almost 1-32 inch, and having on the last fourth plates of

15-32 inch in thickness. The sheer strake is 13-32 inch thick amidships, reduced to 11-32 inch at the ends.

Rivets 5-8 inch in diameter are used for riveting the frames with the reverse frames, floor plates, deck-beam knees, main-deck stringer plates and ties. The rivets in the butts and longitudinal seams of the shell, in the frames for connecting the same with the shell, and in all keelson, stringer plates, and angles, are 3-4 inch in diameter. All seams of the shell plating are double riveted. The butts of the keel plate, deck stringer, center keel, and all tie plates are treble riveted. The center keelson plate has double butt straps of two-thirds of the thickness of the plates they connect. All other butts of the shell plating are double riveted. The bulkhead and bunker plates are riveted with 1-2-inch rivets and the deck houses with 13-32-inch rivets.



THE SCHUETTE COMBINED SCOTCH AND WATER-TUBE BOILER.

The boiler is of the locomotive type, 6 feet 8 inches in diameter, 17 feet 1 1-2 inches long, and built for a working pressure of 140 pounds per square inch. The two engines are of the vertical, triple-expansion, condensing type, having cylinders 10, 15, and 23 3-4 inches in diameter by 8 inches stroke. They indicated 520 horse power at the first trial trip.

Battleships and Cruisers of the Five Greatest Sea Powers.—A most interesting chart on the warship building of the five greatest shipyards is given in the March number of *Marine-Rundschau*. The chart is about 3 by 4 feet, and is laid off with co-ordinance of displacements and years. For each country, England, France, Russia, United States, and Germany, there are two maps, one for the battleships and coast-defence vessels and the other for all classes of cruisers and gunboats. The system adopted is to lay off spots for each ship built, and thus the chart clearly shows the division of warship construction and the variation of displacement during succeeding years. Opposite each spot are given the name, speed, and displacement of the corresponding ship.

A NEW TYPE OF WATER-TUBE BOILER.*

Regarding the question of water-tube boilers in general, practice has shown that the large-tube boilers are easier to clean, while the small-tube boilers give better efficiency and are of lighter weight. Which type of water-tube boiler has a distinct advantage over others, or that can be compared in point of operation and efficiency with the Scotch boiler, it is impossible to say at the present moment, as our knowledge of water-tube boilers for ship use is as yet very meager.

The position that the German Navy Department has taken regarding water-tube boilers is best illustrated through the mixed boiler plants as installed on the latest battleships, *Kaiser Wilhelm II., Kaiser Friedrich III., Wittelsbach,* and others of this type.

In these mixed boiler plants the primary object was to install cylindrical boilers of such power as to suffice for ordinary cruising purposes, and so that when it becomes necessary to get up full speed quickly and steam at the maximum power the water-tube boilers will be placed in service. In these plants the cylindrical boilers are approximately one-third of the power, water-tube boilers of the small-tube, light-weight type making up the remaining two-thirds. The small-tube water-tube boilers were here used, in spite of the difficulty of cleaning, in order to make up for the greater weight of the Scotch boilers, so that the total boiler weight is no more than if large-tube water-tube boilers were used. This has led to the design of a combined Scotch boiler with a small-tube water-tube boiler, called the Schütte boiler, which is of the oval fire-tube type, with small-tube water tubes behind the combustion chamber.

The fire-tube boiler, *c*, of oval or flat form, has two steam drums, *d* and *d*, which are connected to it for almost the entire length by means of collars, *f*. The boiler

*Special translation for MARINE ENGINEERING from an article on the "Water-Tube Boilers for Merchant Ships," by Constructing-Engineer Benetsch, of the Marine Academy at Bremerhaven.

is carried by three lap-welded tubes, *a, a, b,* shaped U-fashion, of about 15 to 20 inches diameter. Into the rear tube are fastened the small water tubes similar to those employed in the Thornycroft boiler. The Schütte boiler consists, therefore, of the following four parts:

First.—A U-shaped foundation, *a, a, b,* which forms the lower legs of the water-tube boiler.

Second.—An oval main boiler with numerous fire tubes, *c.*

Third.—Two steam domes, *d, d,* which are placed across the top of the boiler.

Fourth.—A large number of water tubes, which, by bending them twice, divide the combustion chamber into three parts.

The main boiler is so connected to the foundation tubes by means of brackets that the heating of the various parts will not cause undue strain to any portions of the boiler.

In order to obtain a good water circulation from the main boiler, the foundation tubes and the bottom of the Scotch boiler are connected by means of large tubes, *k* and *l,* and inside the Scotch boiler is a circulating tube, *h.* Flanged connections are made between the various members. The water in this wise passes from the Scotch boiler through the circulating tube *h* down the tube *k,* from which it branches through the pipes *l, l* into the main drums *a* and *b,* from there through water tubes *g* into the drum *d* and back into the Scotch boiler. As the first steam is formed in the water tubes, the circulation is naturally immediately set up on the starting of the fires, which tends in a few minutes to heat gradually the total water in the boiler. The fire on the grate underneath the floor of the fire-tube boiler warms the bottom of the boiler; the gases then pass between the water tubes in the combustion chamber and forward through the fire tubes into the smokestack. On the way to the stack the gases, which are at a temperature of 600 to 700 degrees, pass the forward steam drum *d* and superheat the steam, so that the steam taken from this drum is constantly dry.

Separating the combustion chamber into three parts by means of the tubes has the following advantages: The gases are thoroughly mixed, and a portion of them reach the lower fire tubes better than in the ordinary Scotch boilers.

One difficulty, however, that this boiler possesses is that, owing to its oval form, the top and bottom members have to be connected by means of anchor bolts, marked *n* in the drawing. What on the one hand is detrimental is on the other an advantage, as:

First.—The arrangement of a large number of fire tubes over the whole breadth of the boiler without unduly increasing the height of the same, is possible.

Second.—The better handling in cleaning of the boiler and the combustion chamber forward.

Third.—A good connection to the steam dome, which can be easily cleaned and from which the remaining portion of the boiler can be gotten at through the collars *f.*

After several months' service, scum was found only in the lower chamber, which could be easily cleaned by means of a manhole. The staybolts at the bottom of the boiler are so arranged that in order to clean the boiler they are not in the way of the handholes and manholes *p* and *q* in the forward end of the boiler.

For several years, during which the boiler has been in use at the shipyard of G. Seebeck and on the yacht *Lensahn,* these staybolts have given no trouble whatsoever. They should give no more trouble than the staybolts in a locomotive boiler or in the combustion chamber of a return cylindrical boiler. Their number, too, is much smaller than in the usual boiler of the same heating surface. This boiler is also from 40 to 45 per cent. lighter in weight than boilers of similar heating surface and power of the Scotch type. Without forcing the boiler on starting, in one hour 180 pounds pressure was obtained from feed water of 48 degrees temperature. The circulating apparatus necessary on Scotch boilers is not necessary, as the type of boiler itself effects a circulation. The good circulation has a further effect of tending to keep the small tubes in the rear combustion chamber cleaner than usual, thus obviating one of the objections of this type. Actual investigation showed that these tubes were always clean.

The grates being situated underneath the shell, there is no large body of dead water, as is generally found in Scotch boilers. This water is hard to move and gives rise to many leakages.

		Scotch.	Schütte.
Type		Scotch.	Schütte.
Builders		G. Seebeck.	G. Seebeck.
Date built		1901	1901
I. H. P. at nat. draft		500	500
Heating surface, sq. ft		1711	1685
Grate surface, sq. ft		52 1-4	45 1-4
Ratio H. S. to G. S.		32.6	36.2
Pressure, lbs. per sq. in		190	190
Weight	Bare boiler, lbs.	65,674	37,480
	Boiler and water, lbs.	106,581	55,120
	Boiler, water, grates, uptake stack, covering, etc., lbs.	115,081	65,694 about 43% less
Ratios	Bare boiler / I. H. P. lbs.	131.3	74.9
	Boiler and water / I. H. P. lbs.	213.1	110.2
	Complete boiler / I. H. P. lbs.	230.2	131.4
Consumption coal of 13,500 B. T. U. with feed water from and at 212 deg.		9.5 to 10	10.8 to 11 1

COMPARISON BETWEEN SCOTCH AND SCHUETTE BOILERS.

The two steam domes, which are connected by the pipe *m,* have the same cubic capacity as would be given to the steam room in a Scotch boiler, thus overcoming one of the disadvantages of the water-tube boiler, which is generally deficient in steam space. This allows of a better feeding of the boiler and, as the steam is superheated in the drum *d,* prevents priming to a great extent and insures dry steam. Outside of the man- and handholes there are no connections which can become leaky. In principle the Schütte boiler and the Scotch boiler are very similar and the coal consumption of the two is about the same, consequently some 15 to 20 per cent. better than the water-tube boilers in use on ships. The above table shows a comparison between a Scotch boiler and the Schütte boiler, both boilers being built at the same time at the shipyard of G. Seebeck at Bremerhaven.

The first boiler after these patterns was built at the shipyard of G. Seebeck, at Bremerhaven, for his own use, and such good results were obtained therefrom that the yacht of the Duke of Oldenburg was equipped with the same.

To show the rapidity with which steam can be raised from the cold boilers without forcing, a steaming test was made with the shipyard boiler. This boiler had a heating capacity of 1,540 square feet and a grate surface of 33 square feet, which makes the ratio 1:47. This boiler was in constant use until January 27, 1901, and on January 28, at 5.30 A.M., the temperature was 40 degrees. The trial lasted from 4.45 A.M. until 12 noon.

From 5.45 A.M. to 6.25 A.M., from the time of starting of fire until 15 pounds steam showed on the gage, 800 pounds coal were used; from 5.45 to 6.55, when 191 pounds were registered, 1,380 pounds of coal were used, while in one hour and 10 minutes 16,600 pounds of water were brought from 40 to 369 degrees.

VESSEL.

Builder	Howald, Kiel.
Length between perp.	142 ft. 6 in.
" over all	174 " 9 "
Beam	25 " 3 "
Draft	11 " 7 "
Displacement	465 tons
Wetted surface	4,315 sq. ft.

ENGINE.

Type	Triple exp.
Builder	Howald, Kiel.
Revolutions per minute	180
Pressure	190 lbs.
High-pressure engine	13 in.
Intermediate "	19 3-4 in.
Low-pressure "	31 1-2 "
Stroke	18 in.
No. Boilers	2

BOILER

Type	Schütte.
Builder	G. Seebeck.
Number	2
Grate surface, total	90 sq. ft.
" " each boiler	45 " "
Heating surface	3,280 sq. ft.
" " each boiler	1,640 " "
Pressure	190 lbs.
H. S. ÷ G. S.	36.2

TRIAL RESULTS.

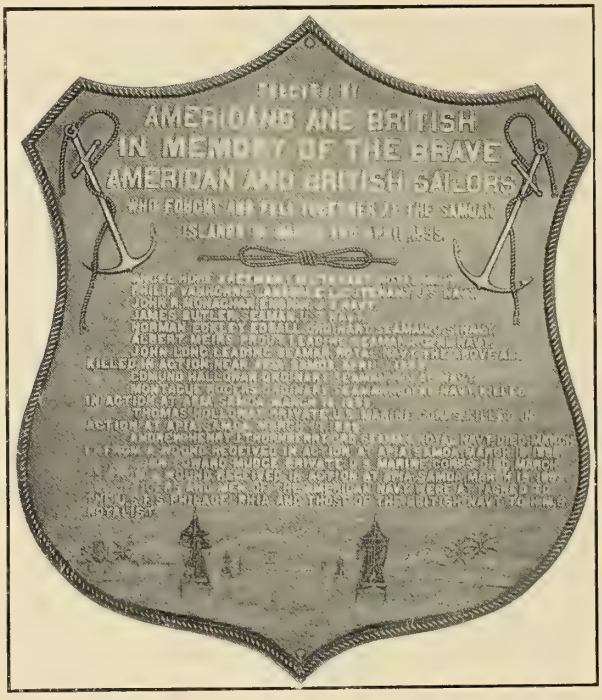
Speed, knots	13.8	14.25
I. H. P.	860	1068
Cut-off H. P. cyl.	.6	.76
I. H. P. per sq. ft. G. S.	9.55	11.90
I. H. P. per sq. ft. H S.	.25	.32

TESTS OF SCHUETTE BOILER.

At 7 o'clock the machinery of the works began operation; from 7 until 12 noon coal weighing 3,685 pounds was consumed, with a resulting evaporation of 29,500 pounds of water, the feed-water temperature being 46 degrees and that of the steam at 396. The resulting evaporation was 9.9 pounds of water per pound of coal from and at 212 degrees; 24 pounds of coal were burned per square foot of grate per hour.

Herewith are given table of dimensions of the yacht which was fitted with boilers of this type, and the results of a six-hour trial, during which 1,068 H. P. was developed on 1,760 pounds of coal per hour. This would be a consumption of 1.68 pounds of coal per H. P. per hour, including all auxiliary machinery, steering engine, etc., which is very economical for so small a plant.

This type of boiler could be properly installed with slight modification in launches, etc., on account of its quick steaming and adaptability, and at present an auxiliary boiler of this type is being built for the cable ship *Nordenheim*, building at the Vulcan Iron Works at Stettin. This boiler will have 9.5 square feet of grate, 300 square feet of heating surface, and will be designed for 150 pounds of steam.



Bronze Tablet for American and British Sailors.

The first monument ever erected to commemorate the deaths of American and British sailors fighting side by side is shown in the accompanying engraving. It is a bronze tablet about 3 1-2 feet square with a design and inscription in bas-relief. The tablet is erected in the Chapel of St. Peter at the Mare Island Navy Yard, California, and was unveiled on July 17, 1902, in the presence of Admiral Merrill Miller, several officers attached to the station, American and British sailors and marines, and citizens of Vallejo and San Francisco. Upon the tablet are engraved the names of the officers and men who fell during the brief war in Samoa in 1899.

Six-Masted Schooner.—The work of building the six-masted schooner *Wm. L. Douglass*, at the Fore River shipyard, is being pushed night and day. The vessel is in frame and it is expected will be launched in August.

COAL BARGES AND TOW AT POINT PLEASANT, KANAWHA RIVER.

THE COAL FLEETS OF THE GREAT KANAWHA RIVER.

BY H. C. FITHIAN.

Under the heading of the "Ohio River Coal Fleets," published in Marine Engineering for October, 1901, were described by the writer some of the unique features of this immense inland commerce, and the present article has been written to continue the general subject and give further particulars, especially applying to river traffic on the Great Kanawha.

The towboat, unlike the passenger packet, has no set time of arrival and departure. As a rule, when in port the boat is engaged in harbor duty. In fact, while steam is up it is seldom that the boat is not on duty.

Each large coal company has several harbors within a few miles of one another at the terminals. The harbors form what might be called the company's storehouse, where the barges are accumulated for future disposal. The harbors are in sheltered spots on the river banks, affording protection to the barges against ice and current. The barges in the harbor are usually referred to as the "fleet," as distinguished from the "tow." In the fleet the pieces are not placed with the same rigidity as they are in the tow, and, owing to the swells from passing boats, wind, rising or falling water, etc., loosen their connections somewhat and need to be "straightened up," which is done by the regular towboat in the absence of the harbor boat. The latter is a small towboat capable of handling a few pieces at a time between different landings.

The steamboat seldom lays up at Cincinnati; after delivering her loaded pieces to the different harbors, she "hitches up" her tow of empties for the return trip, generally on the same day. The steamboat generally lays up for a few days at the upper end of the route.

On the morning of the 24th of February the tow, made up of steamer *E. R. Andrews* and thirty-one pieces, all but two of which were empties, left the harbor at Coal Haven, Cincinnati, Ohio, bound for Point Pleasant. The craft of the tow are placed ahead and the smaller ones in the "pool or duck pond," which is an open space directly ahead of the steamer. In this instance the fuel flat and *Boy* were the only pieces not empty and were placed inside of the "pond." The fuel flat, which carries coal for the steamboat, is in general like the barge, except that it is of smaller dimensions than the barges, being about 90 feet long, 18 feet wide, 6 feet 6 inches deep, and holding approximately 5,000 bushels. The *Boy*, the name given to this particular barge, was a small flat about the size of the fuel boat, housed in, and contained stock for the company's stores at the mines.

Three other pieces were picked up on the way, and we arrived at Point Pleasant, which is at the mouth of the Great Kanawha, with thirty-five, including the steamer. Fog and wind were here met with, and it was surprising to note the effect that little wind, apparently, had on the mass of "lumber"—empty barges. On account of the wind, it was necessary to land one-half of the tow on the Ohio bank and double up in order to enter the mouth of the smaller river. The passing of a packet is dreaded by the pilot of the towboat, on account of the heavy swells produced, especially on the smaller rivers. We had one experience of this on the Kanawha, where it was necessary to stop the wheel and float for fully one-half hour before it was safe to go ahead. The swells are sufficient to break up the tow, for they are, as termed by these river people, "whip-crackers."

The method of towing on the western American rivers differs from all others, in that the tow is pushed instead of pulled.

Doubling up outside the point, we landed the tow of empties in two sections in the upper harbor about two miles above the mouth, and, dropping back one-half mile to the fleet of loaded pieces on the Henderson side, we laid up for over a week on account of the high water. A view of the Kanawha, looking toward the Ohio, is here given; it was taken from the railway bridge and shows the tow in the foreground on the Henderson side of the river, and the town of Point Pleasant in the background with dry-docks, landing, and general shipping.

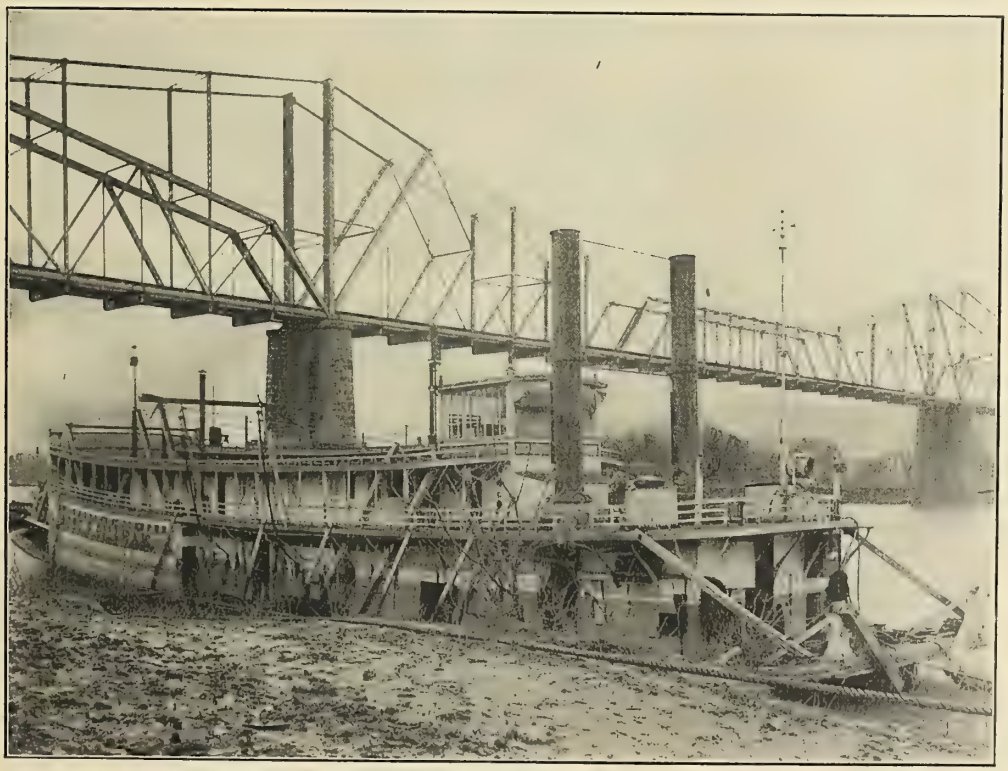
During the time that the boat laid up, I made a trip on the *D. T. Lane,* referred to in the April number of MARINE ENGINEERING, to Mt. Carbon, which is at the head of the navigation on the Kanawha, 91 miles from the mouth. The trip was made in four days and every moment was of interest. Naturally the nights were not adapted to observation, but the clever pilot supplied this deficiency in great measure. This river is a tortuous stream, mostly of a rocky bed, and with many shoal places. To overcome these latter the government has constructed a system of dug chutes, and locks, and dams. The dug chutes are formed simply by dredging the channel; the material taken out, being mostly of rock, is dumped on either or both sides. There are no special forms for making chutes; they are built in accord with the needs of navigation. Some are as much as 1,500 or 2,000 feet long, and often are made in extremely sharp bends of the river. On this trip, as the chutes were entirely covered by the high water, in two instances a narrow line of willows was pointed out as the line, the trees seemingly growing out of the water. It was very clear that the pilot needed to be intimately acquainted with his river in all its stages, as well as with the unwieldy mass in front of him.

At Mt. Carbon, where the river is narrow and the hills are high, the banks on both sides are lined for miles with hundreds of coke ovens, which emit great volumes of smoke and fire, and when seen in the darkness through a heavy atmosphere are most striking. The coal is brought from the mines, which in some cases are six miles away, in small cars holding about 60 or 70 bushels. Along the river banks are several "tipples" for dumping the coal from the cars into the empty barges or pieces. These tipples are small wooden structures built on trestles well out over low-water mark, but on a level above any probable high water. The cars are run into the tipple house and the coal unloaded into a V-shaped box. An endless chain with buckets scrapes the coal from the box upon screens of different size openings, which sort the coal out according to size, from lump to slack. As it falls through the screens it is caught in hoppers or sliding bins which lower and discharge it to the barges below. It takes from five to nine hours to load a barge, and a tipple can handle about 1,500 tons a day. Some are made to load into either cars or barges.

STEAMER D. T. LANE LOCKING THROUGH ON THE KANAWHA RIVER.

Returning down the river, we passed through locks Nos. 2 and 3 by daylight; the picture of No. 3, showing the *Lane* locking through, was taken at 6.30 A.M. The locks are the same in general as the old-fashioned canal locks, except that they are more substantial. The lock-pit, or chamber, is built of stone, the walls 6 feet wide, and with room enough to admit two barges and the

CABIN, LOOKING AFT, OHIO RIVER TOWBOAT.



THE ROBT. P. GILHAM, ONE OF THE COAL FLEET TOWBOATS.

steamboat at a time, or four barges two abreast. The dams of Nos. 2 and 3 are what are termed fixed dams; all others on this river are movable. The fixed dam is simply a stone wall extending from the outer lock wall to the abutment on the opposite shore, the face of the wall slanting down stream. The lock is the same as in all the others; there is no "navigable pass," as the lock is used at all times, excepting in extremely high water when the level of the water over the dam is deep enough for boats to pass over.

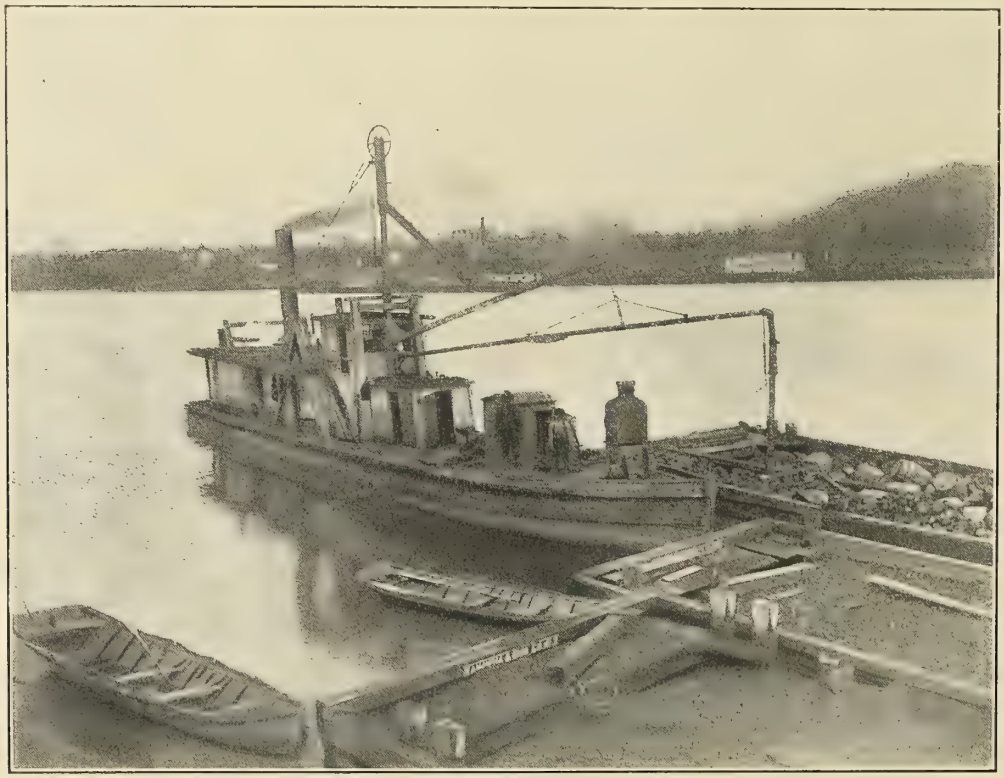
There are ten dams altogether between Mt. Carbon and the mouth of the river, No. 11 being the last one built, about three miles above Point Pleasant, and No. 1 having been contemplated, but either abandoned or left for some indefinite future time. The lock is built close to the shore, and beyond the outer lock wall is the navigable pass, which is a space wide and deep enough for boats and tows to go through in certain high stages of water. A pier extends from the pass to an abutment which sustains the weir or dam proper. In times of low water the fall over the dam is from 16 to 20 feet.

The movable dams are constructed so that the gates or wickets can be lowered to a level with the bed of the stream, and are always let down in seasons of high water, which sometimes is so great that boats and tows use the stream its full width. The illustration of lock 11 which is herewith presented shows the dam in course of construction, the lock walls and chamber completed, and the pass and the weir as they appear when up.

The weir gates are held in place by a series of pivoted angle props or braces. These props are raised by a chain and windlass which runs on a track laid in sections on the top of the props as they are drawn in place. After the props are swung up, the winch raises the gates, which operate practically like a book when laid open face down on the table and raised from the back.

In locking through with a towboat going down stream, the steamboat pushes four of the barges, two abreast, into the pit, casts away, and backs out. The upper gates are closed and the valves in the lower gates are opened by a winch to allow the water to escape, thus leaving the vessels on the level of the stream below, and the upper gates holding back the water above. The gates are opened and shut by two goose-neck levers which swing into recesses flush with the sides of the chamber. When the lower gates have been opened, the barges are floated out and landed at some convenient place below, and in turn all the other pieces are locked through in this manner. The steamboat, which is the last to go through, must reassemble the tow with about the same labor that is required in hitching-up at the harbor. This tedious operation must be repeated, of course, at each of the locks. The illustration of the *Lane* going down stream shows in part the rip-rap-made shore, the lock wheels, the gates and dam. The waterfall over the dam was not more than 3 or 4 feet, and scarcely shows as it might in times of low water.

In low water, to save time and labor in locking through, the tows are made up two abreast without the pool and bearing is made direct from the head of the boat to other barges or fuel flat. The tow, stern, and bridle lines are placed in this arrangement the same as in the large river tows, and the formation avoids the necessity of breaking up in locking through.



STEAM PUMP BOAT, WITH SUCTION PUMP CONNECTED TO BARGE.

STEAMING DOWN THE KANAWHA—VIEW FROM THE HEAD OF THE TOW, SHOWING LINES OF STEAM SIPHONS.

BUILDING LOCK NO. 11, KANAWHA RIVER.

The barges are built to some extent by the coal companies in rough yards on the edge of the river bank. When completed a barge is skidded on to a wooden track (ways) inclining into the water, and is "let go" broadside to the river. The barge is positive in its demand for water outside, while continual work is required, maybe, to keep the water from the insides. The steam siphons used for this work are shown in the engraving, page 301. Steam is carried in pipes the full length of the tow, whether 150 or 700 feet, and, as they are gluttons for steam, and often rob the boat of her supply, the boilers must be of ample capacity to perform the duty of this double service. The pump boxes are of wood, four or six in number, placed on both sides of the barge, measuring about 18 by 30 inches, and extending to within a few inches from the bottom. There is always some water in the boats, and when it reaches 8 to 12 inches pumping begins. Another means of clearing the water is by use of the funnel, which is a galvanized iron tube 18 inches long, 3 inches diameter at the top, tapering to 2 inches. This is driven through a plank in the bottom of the barge, large end upward, until it approaches only 3 or 4 inches above the plank. A rubber hose is fitted on the small end of the funnel and a hole bored through a plank in the bottom of the barge. The small end is put in first and the funnel down until only 2 or 3 inches are left above the plank. When the barge is in motion, the rubber hose will naturally turn toward the stern and the suction will draw whatever water is in the barge down through the funnel and out. But no one of these processes can keep the barges dry. Each barge carries its hand pump, which consists of a wooden square box with a spout, leather valve, and rod operated by two men either by direct lift and push on the plunger rod or by a long stick spring lever.

In the harbors the pump boats are used, one a steamboat, and the other a flatboat. The first is equipped with a steam propeller and is sometimes even used in harbor towing, while the other is dependent on some outside source for propulsion, but has a steam capstan. It is, however, the more common of the two. These pump boats are equipped to use either the suction or siphon, singly or together. A pipe for the suction pump is carried on a crane extending over the bow of the boat, long enough to reach across the width of a barge on either side, thus giving access to a fleet four wide. In the view of the fleet on page 297 this flatboat is seen in the open-water passage, or pool, at the center of the tow. A large fleet, such as ours, requires two pump boats, one in the center and the other on the outside. These boats are also used to spar the fleet away from the bank in falling water. A spar is placed against the bank and a line attached to the other end is led to the steam capstan, and by this means the boat is pushed from the shore.

TIPPLE FOR LOADING COAL AT CAMPBELL CREEK ON THE KANAWHA.

One feature of river towing which is an evidence of activity is the portable telephone outfit which the boat is supplied with. From a permanent pole on the bank, which carries a telephone wire, connection is made, as soon as the boat lays up at terminal, to a wire on a windlass on board, hung against the inside of the "roof" forward of the cabin bulkhead, and connected up to the instrument in the cabin. A wire runs over a pole to take up the slack when the water is rising and to let out when

the water is falling. By the use of these stations the steamboat is at all times connected with local and long-distance telephone lines, except when under way. At different points en route mail matter was sent ashore and collected by the yawl.

After a week's delay at Point Pleasant, on account of high water, the captain finally gave the order to "hitch up" and make ready to leave for Cincinnati as soon as possible. The news was indeed welcome. When the work of heading up was started, the steamboat cut loose from the harbor fleet and began a selection of the particular pieces which she must take down the river. These are drawn from the fleet, one, two, or three at a time, and, in the meantime, the lashing ratchets, chains, and lines are distributed to the pieces which are to be taken, for the lines and lashings on the fleet belong to the harbor and must be exchanged for the boat's lines. The smaller craft, usually the fuel flats, are selected first, and form the pool. These are landed at a convenient spot and one-half of the crew stay with the tow while it is being made up, and the balance remain with the boat, which returns to the fleet for more pieces. As fast as two or three are swung into position, the men on the tow lash up and ratchet them, so that when the last pieces are brought up and placed, the tow is practically completed. The work of necessity requires much time, as often the barges needed are at the inside of the fleet. There is plenty of hard work for the entire crew, from the captain down, in making up a tow. When all is completed, the steamboat swings out into the stream, takes her place at the foot of the pool, the shore lines are cast off, and, backing out into the stream, the steamer is ready for the start. Then the crew resume their watches and those on watch nail the splash boards to the outside edges of the outer barges. These are rough boards 12 inches wide and are used to keep the waves, stirred up by wind or passing boats, from sweeping over the sides or heads of the barges. The trip down the Ohio was completed without further incident.

Explosion of a Gasoline Yacht.

The yacht *Vagabond,* propelled by gasoline and equipped with an acetylene lighting plant, blew up on May 16 in the East river, New York. The owner, Mrs. J. B. Gibson, and several of the crew were more or less burned.

The exact cause of the accident is not given out, but it appears that the gasoline fumes were exploded by the acetylene lighting plant. When one of the gas jets was lighted in the cabin an explosion of gasoline followed. The yacht had been prepared for a summer cruise and there was much valuable property of the owner on board. After the explosion the vessel took fire and sank at her moorings.

The Largest Freighter of the Lakes.—A vessel of 500 feet length over all, 480 feet keel, 52 feet beam, and 30 feet depth has been contracted for by Cleveland parties with the Columbia Iron Works, St. Clair, Mich. The vessel will be longer by two feet than the four largest ships built by the American Shipbuilding Company. It is stated that Mr. M. A. Bradley closed the contract for the vessel.

SIMPLE METHODS OF TESTING OILS.

BY J. K. NYE.

A short time ago the writer in an idle moment evolved a rambling article on the subject of "Lubrication," which this worthy journal took in hand and published. It brought forth a letter from a marine engineer whose high standing in his profession proves very conclusively what the writer in his humble way tried to prove: that nearly all the oil purchased by marine or any other engineer was bought purely upon the assertion of the smooth-tongued drummer, and not because said engineer had any knowledge of the physical qualities of his lubricant. Of course no engineer can go very deeply into the chemical testing of his oil; but he can a little, and he can get the all-sufficient information by mechanical methods.

Three things he can easily learn to determine: viscosity, gravity, and fire test, and we will deal with them separately.

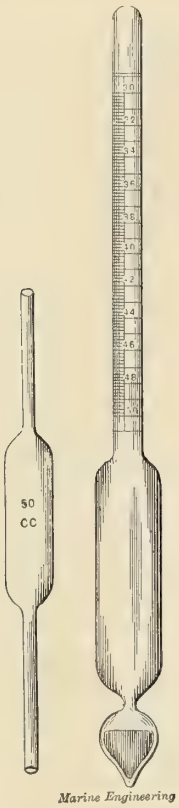
VISCOSITY.

The first is perhaps the hardest, because all viscosity of oils, whether put out by the Standard Oil Company or other makers, is based upon an arbitrary standard, so that any viscosity test which is made in a rough way can only be made *relatively.* At any chemical warehouse can be purchased what is known as a pipette, which we herewith show in Fig. 1, consisting of a simple glass tube with a bulb blown in the center; the lower end of the tube is drawn to a tiny point and above the bulb is marked a ring on the glass. The operation of the instrument is as follows: The oil is drawn into the tube by suction of the mouth up to the ring. A finger is placed over the top, preventing the escape of oil, and holding the watch in one hand, the tube in the other, the finger is suddenly lifted off and the oil is allowed to flow out, the time of such flow being taken. The number of seconds required can be the engineer's standard of viscosity; that is, having taken a sample of oil which suits him, he places it in some position where it can be heated to a convenient temperature, say 70 degrees Fahrenheit. After he is sure of his temperature he fills his tube as above described and allows it to run away, and makes a memorandum of the number of seconds. The same performance must be gone through with every oil which he wishes to test. If it runs out in a less number of seconds the viscosity will be known to be less than his standard; if it takes more time it is greater than his standard. As I said above, this is a relative test, but a little practice will be a great education for an engineer in connection with the other test to follow, and if persistent he will soon become proficient in judging the *relative* viscosity values of his oil.

Now, right here it may be well to poke around a bit in what is called "molecular construction." In a previous article I referred to the little microscopic pits which even the finest turned bearing or cylinder is bound to contain, and there tried to show their relation to lubrication. This same condition exists in oils also, although in their case the "molecular construction" is far beyond the power of the microscope to show, so that while the engineer is performing the above viscosity test let him try to conceive the oil being composed

of tiny little globules or balls of lubricating matter. He can readily see that the rate at which they crowd out of the tiny hole at the bottom of the pipette will be largely due to their size. There even might be imaginable such a thing as one molecule too large to come out at all if the hole were fine enough.

Now, having conceived of this pipette full of little balls of lubricating matter which are running like the sands out of an hour-glass, there will be shown another feature connected with them, and which would regulate the speed of flow independently of the size of the molecule, namely, the phenomenon which a scientist would call "surface tension," but which we will term "the difficulty which one of the molecules or balls experiences in trying to pull away from its next neighbor."



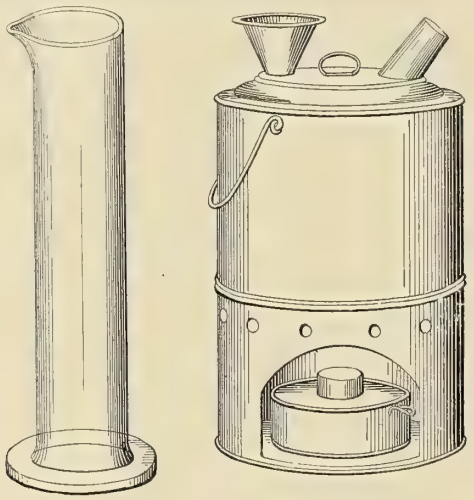
Marine Engineering

FIGS. 1 AND 2.

As an illustration, let the engineer take a piece of very fine wire, bend the end into a loop, say a quarter of an inch in diameter; if he dips this into a little soapy water he can pick up a film of fluid, which will extend clear across the loop, and which, being blown upon, he will find really has considerable strength. Various liquids (most oils included) will make such a film, and, while it generally varies with the viscosity, seeming to have considerable relation to it, it is also strong proof that the molecules of some kinds of liquid have a stronger affinity for each other than others, and if this is so it is plain to our minds that in crowding out of the tiny hole in the pipette some liquids must cling together with more strength than others and thus retard the flow. If this is the case, oil between two moving surfaces of metal must operate much in the same way. Heat reduces viscosity and also reduces this "surface tension," so that an engineer in studying his relative viscosity of a cylinder oil must take into consideration the heat of his steam, and, other tests being satisfactory, choose that oil which will give him the best film effect for his particular steam temperature and piston speed.

SPECIFIC GRAVITY.

The next test should be for gravity. The specific gravity of any substance, solid or liquid, is its weight compared with an equal volume of water; and while again it is impossible for the engineer to go into the determination of absolute gravities, since the gravity of all oils is based upon an arbitrary standard, it is easy enough for him to get close to the true gravity of the mineral oil by means of a little instrument called a hydrometer, Fig. 2, which costs but a very few cents at any house selling chemical glassware. He will need a long test glass, say 12 or 14 inches high, 2 inches in diameter, such as shown in Fig. 3, and which is also a



Marine Engineering

FIGS. 3 AND 4.

cheap affair, for sale at a chemical glassware house. Into this he pours his sample of oil to be tested and then floats the hydrometer. In the tube of the hydrometer is marked a scale, which just simply floats higher or lower as the liquid may be lighter or heavier in gravity. Of course here again the temperature must be carefully taken, and all tests of samples must of course be made at the same temperature, the best and most convenient being at 70 degrees. Any temperature can, of course, be selected which is most convenient for the operator, and it is best always to consider these tests relatively, that is, one *known* sample against sample on trial.

FIRE TEST.

The third lubrication test which it is possible for the engineer to make is the fire test. All are thoroughly familiar with the term—for what engineer has not had to stand before the drummer and either laughed or cursed at his endless harangue over this self-same "fire test"?—and it all means simply this: Any oil, if sufficiently heated, will give off a vapor at a certain temperature. This vapor rises slowly, and upon the application of a tiny flame the mixture of such vapor with the air on the

surface of the heated oil ignites and burns with a momentary flash. This is termed the flash point. If the temperature be increased the amount of vapor increases until it becomes rapid enough to support a tiny flame. At this point is the fire test, the drummer's trump card.

Now, for the determination of this fire test the engineer needs only a simple apparatus, which he can buy or easily make. It consists of a little metal standard shaped something like a petticoat, under which an alcohol lamp can be placed, and on the top a shallow dish to hold the oil to be heated. This should be about 2 inches in diameter and an inch deep. The whole thing is shown in Fig. 4. In addition to this the experimenter will need a thermometer registering up to, say, 800 degrees, which can be purchased at any supply house, and it should be supported so that the bulb hangs well covered by the oil in the little pan. As the temperature slowly rises the engineer should provide himself with a number of wooden toothpicks shaved down to the tiniest point. When the thermometer has risen to the point at which a test should be made, light the end of a toothpick, making the smallest possible flame, and pass it quickly over the oil. If a flash or burn, as before stated, occurs, this will be all the engineer cares to know.

With the above-named outfit or apparatus, a little perseverance and experiment, any user of oil will gather in a goodly store of useful knowledge. He will eventually arrive at the point where a brand of oil will mean very little to him. He will be able to ask his dealer for an oil of a certain gravity, viscosity, and fire test. He will be able to examine such oil and prove for himself whether he gets requirements or not. As I have before stated, if this practice was general among engineers and buyers of oil, all brands would in time disappear from the market—a state of affairs which would save untold thousands of dollars to users of machinery, and it is the writer's hope that some of them may think it worth while to take up this rough line of experiment.

As an interesting line of thought for an engineer to follow while carrying on these experiments, perhaps a few words on oil in general may not be out of order. Almost all oils possess, in a greater or less degree, ability to evaporate; this more particularly in the case of hydrocarbon or mineral oils, while the fixed oils, oils made from animal or vegetable matter, possess it in a very small degree. If a straight hydrocarbon oil be used where the heat is high, as in a steam cylinder, it would in time completely evaporate. This is a very proper condition if the time is not too long. In order to counteract this tendency to evaporate, some dealers use animal oil in mixture with hydrocarbon for use in steam cylinders, but any mixture of animal oil does not prevent the hydrocarbon from evaporating first, leaving the fixed oil to gradually decompose under the heat. Most oil dealers tell the engineer that the high fire test overcomes this; but it will be an interesting experiment for the engineer to take a small quantity of this oil, place it in a concave piece of glass (a heavy watch crystal will do), let it lie for a long time on a cylinder head or in some place where it will be subjected to the temperature of the steam, and he will see that, no matter how high its fire test, the oil will gradually lessen in quantity. If animal oil has been mixed with it, it will in time leave a thick residue, or even pass to the solid state.

Finishing I wish to repeat that the above tests are simple methods and only relative. There are many more which are really within the scope of the average engineer, and, having familiarized himself with these, others will suggest themselves; but simple as they are, if adopted by steam engineers in general, the purchase of oil would be based upon its usefulness for specific cases. Brands would disappear, and one would buy his lubricants as he now buys his tea or sugar or coffee or flour.

Mosley Industrial Commission.

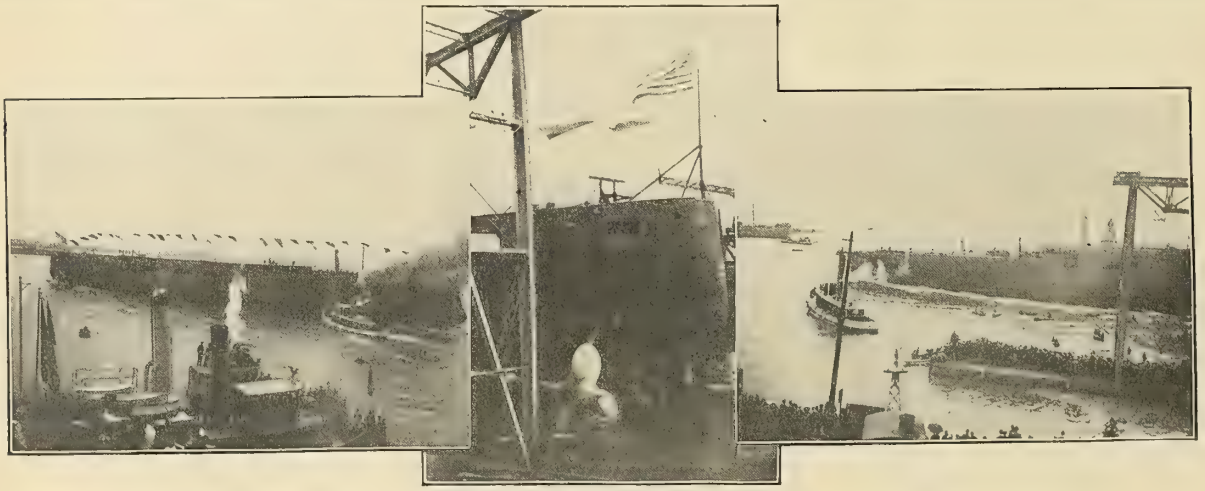
The report of the Mosley Industrial Commission has just been issued, forming a voluminous publication of some 280 pages, containing the reports of twenty-three contributors. It will be remembered that Mr. A. Mosley, an Englishman, offered to pay the expenses of representatives of the different English trades on a tour of inspection to the United States for the purpose of visiting our great industrial establishments, to learn of the conditions surrounding the workmen in this country, and if there were any causes apparent for the superiority of American methods of manufacture. Mr. Mosley has traveled extensively, and, while in the United States, he was impressed with the better condition of American workmen, and that as a manufacturing country America was forging ahead at a pace hardly realized by either British employers or workmen.

Before leaving England Mr. Mosley gave to each of the twenty-two members, each of whom was selected from a trade union, a list of questions which he requested them to answer as far as possible. These were forty-one in number and dealt with the early training of the workmen, the relations between employer and employee, and general conditions of workers outside the factory. While in many cases the answers are, as might be expected, contradictory, the general report of the delegates is in agreement. It is well to have the side of the laborer presented, but Mr. Mosley's own report is of far greater value, as it comes from a thoroughly-educated and broad-minded man who has the interests of his country at heart. Mr. Mosley's claim is that the "true-born American is a better-educated, better-housed, better-fed, and better-clothed and more energetic man than his British brother, and infinitely more sober; as a natural consequence he is more capable of using his brains as well as his hands." The reports of the delegates in general bear out this view, although there are, of course, some exceptions—as for instance, one delegate considers the American workmen are too well fed. On the question of drinking all are practically agreed with Mr. Mosley's statement as above expressed. Also all practically agree that the American workman has a sounder education, largely due to the fact that in the public schools the rich meet with the poor and give to them a certain culture, and, at the same time, both are benefited by knowing personally some of the other class. This acquaintance educates a man in the knowledge of how to get along with others, and it is invaluable in later life.

Concerning the relations of employer to employee, Mr. Mosley states: "In England it has been the rule

for generations past that as soon as a man earns beyond a certain amount of wages the price for his work is cut down, and he, finding that working harder or running his machine quicker brings in the long run no larger reward, slackens his efforts accordingly. If this is to be the case can we blame the workman?" We are sorry to state that this custom is not unknown in our own country, but British manufacturers are already realizing their mistake in adopting this plan.

Most of the delegates were surprised to find that Americans did not work so extremely hard or long as was supposed; while their hours are longer than in England they are much better paid and make good use of their leisure. On the whole the opinion appears to be that the American is better off than the Briton, when considered from the point of expense and wages, by



VIEWS TAKEN AT THE LAUNCHING OF THE U. S. CRUISER COLORADO FROM MESSRS. CRAMP'S SHIPYARD.

about from 20 to 25 per cent. The use of labor-saving machinery, the delegates believe, is one of the most important reasons for the progress in this country, which we Americans fully realize.

While the report does not confirm the rash statements of the daily press on both sides of the Atlantic as to the superiority of the United States in all lines of manufacture, it does indicate in what lines our success is gained. What better comparison of the condition of labor in the two countries can be had than by the fact that so many English and Scotch artisans are to be found here in this country? They come to us well trained in their professions and here they are given the opportunity to progress, and apparently make the best use of such opportunity, for they are to be found in positions of importance. One of the greatest differences, as pointed out in the report, is in the attitude of the manufacturers toward their men. Successful Americans have frankly acknowledged that a great part of their success, if not the greatest, has been in finding capable men to fill responsible positions, and that they are constantly on the lookout for *brains*.

LAUNCHES.

U. S. S. Colorado.—On April 25 the armored cruiser *Colorado* was successfully launched from the William Cramp and Sons' Ship and Engine Building Company's shipyard. The ship is 502 feet on the water line, 69 feet 6 1-2 inches extreme beam, and, when fully equipped and ready for sea, is to have a mean draft of 24 feet 1 inch and a displacement of 13,680 tons. She is to be driven by twin-screw, triple-expansion engines at a speed of 22 knots for four consecutive hours. Niclausse boilers are installed. The ship has two 8-inch barbette turrets, one forward and one aft, and two military masts. The armor is made by the latest improved Krupp process and consists of a water-line belt 6 inches amidships and 3 1-2 inches at the ends; barbettes of 6-inch armor and turrets 6 and 6 1-2 inches thick. In each turret are mounted two 8-inch B. L. R. guns, and in the superstructure on the gun deck are fourteen 6-inch R. F. guns; these are mounted behind 5-inch armor and a belt of cellulose extends from stem to stern above the protective deck. The secondary battery consists of eighteen 3-inch R. F. guns, twelve 3-pounder R. F., eight 1-pounder R. F., two 3-inch R. F. field pieces, two machine guns, and six automatic guns. The 8-inch guns are designed to fire once every fifty seconds and the 6-inch guns once in twenty seconds. The contract price for the *Colorado is* $3,780,000.

Steam Yacht Haouli.—The steam yacht *Haouli* was launched recently at Erie Basin Dry-Dock, Brooklyn, N. Y., built from plans of Mr. Henry J. Gielow. The yacht is for Mr. S. M. Smith, of San Francisco, and is 211 feet 3 inches over all, 106 feet on the water line, 21 feet 6 inches beam, and her draft will be 9 feet. Four-cylinder, triple-expansion engines, designed to indicate about 1,800 horse power, will be furnished with steam by four water-tube boilers. The vessel is very handsomely fitted out for long cruises.

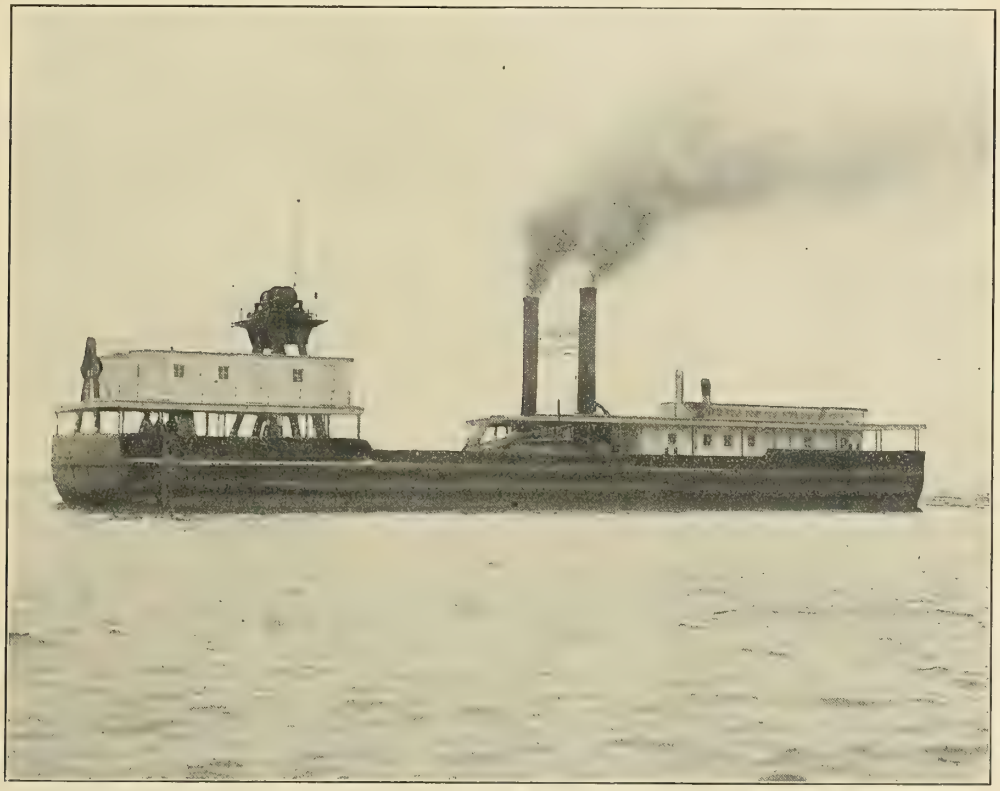
Steam Yacht Czarina.—A fine single-screw steam yacht was launched on April 4 from the Crescent Shipyard, Elizabeth, N. J., and christened the *Czarina*. The principal dimensions of the vessel are: Length over all, 172 feet; on water line, 140 feet; breadth, molded, 22 feet; depth, molded, 12 feet 6 inches; draft, 9 feet 6 inches; displacement, about 300 tons. A description of this yacht will be presented in a later number of MARINE ENGINEERING.

CANADIAN-BUILT HYDRAULIC DREDGE.

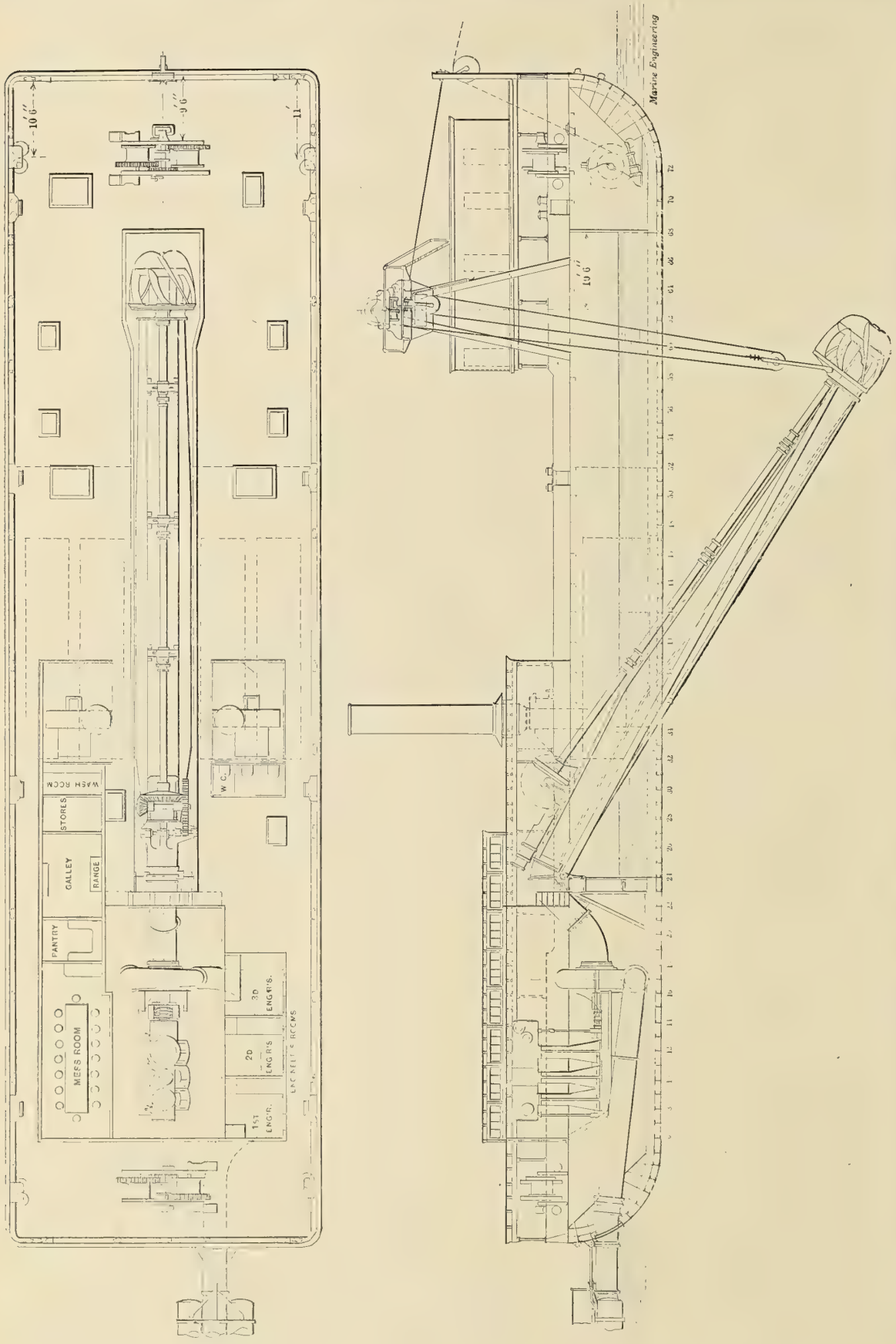
There are abundant indications that a great wave of commercial prosperity has commenced to roll over Canada, coincident with the dawn of the new century. There is no boom, but a steady onward progress of increasing volume and momentum, showing that the men of the northern zone, whilst realizing and appreciating fully the well-known maxim *Festina lente,* are beginning in earnest to develop the immense possibilities of that land wherein Nature has been and is so bountiful with her gifts.

Canadians are alert, energetic, and intelligent, prone to be cautious rather than over-sanguine, and, with such characteristics, they can be relied upon to build up their young country upon the solid rock of sound commercial principles. They are justified in looking forward with a spirit of hopeful confidence to the future development of their country, because the possibilities of the Great Northwest, the satisfactory condition of general business throughout the Dominion, the high price of Canadian securities upon the London Stock Exchange, the immense influx of immigrants from the United States and Great Britain—all of them being of a superior class, many comparatively wealthy—the scarcity of labor, the upward trend of wages, the growth of manufacturing industries, have at last, apparently, penetrated the highly-tempered steel armor of British exclusiveness and conservatism to such an extent as to induce a party of at least fifty members of the British Parliament to make a tour of the country and convince themselves whether the optimism of the Canadians is well founded or not. There is not much doubt but that the distinguished visitors will return, as did Queen Sheba of old, saying "the half had not been told them," with the result that, at any rate, a goodly portion of the stream of British gold which has hitherto been poured out so lavishly in Africa and elsewhere will become directed toward "Britain's foremost colony," to the manifest advantage of the investors as well as the colonist.

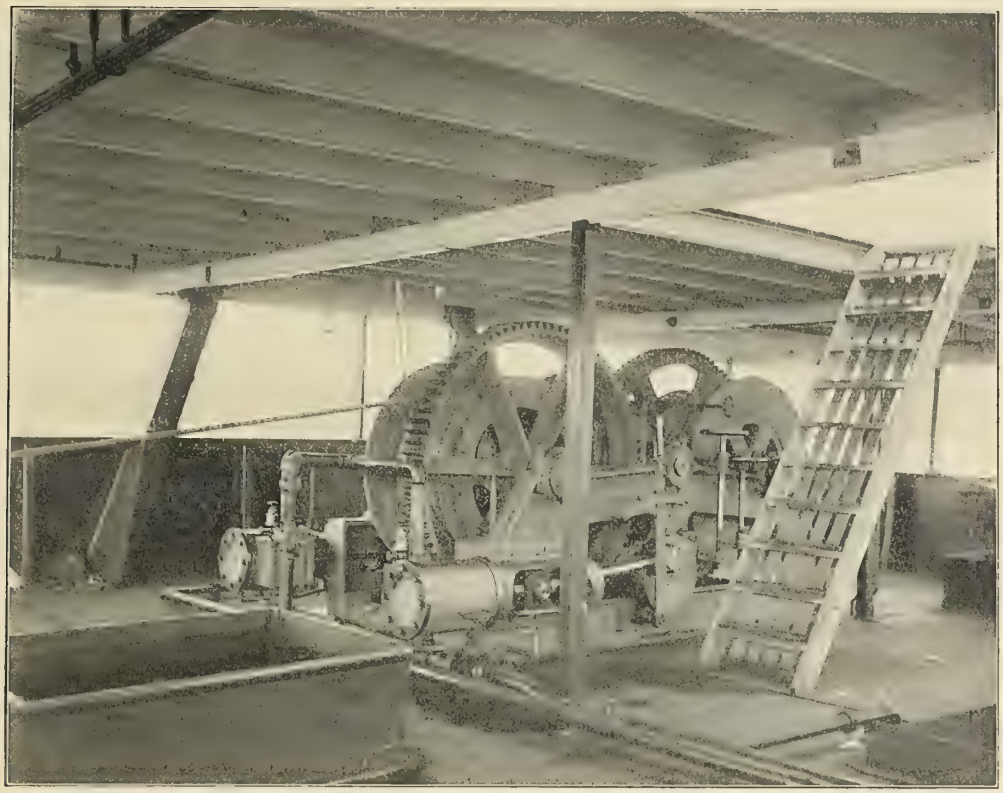
One of the evidences of this prosperity and progress is seen in the successful building of a modern steel hydraulic dredge, named the *J. Israel Tarte,* by the Polson Iron Works, Toronto, Ont., for the Dominion government. This vessel is one of the largest and most powerful dredges of its kind ever built, and represents the highest development of engineering in this direction. The hull is built of steel throughout, is 160 feet long, 42 feet beam, and 13 feet deep. It is constructed with an open well in the center 80 feet long, through which the huge suction pipe operates. This suction pipe is 40 inches square and is built in the form of a square box girder, having extended flanges of great width to resist the strains of coming in contact with the bottom. At the lower end of this suction pipe there is an immense cast-steel rotary cutter 9 feet 6 inches diameter and weighing 10 tons. The cutter is driven by a pair of double-tandem compound engines mounted on top of the girders at the upper end. These engines are of 300 I. H. P. and are of massive construction. The cutter is designed to excavate hard clay, or other difficult substance other than stones or rock, without difficulty. It is sufficiently strong that if any immovable resistance,



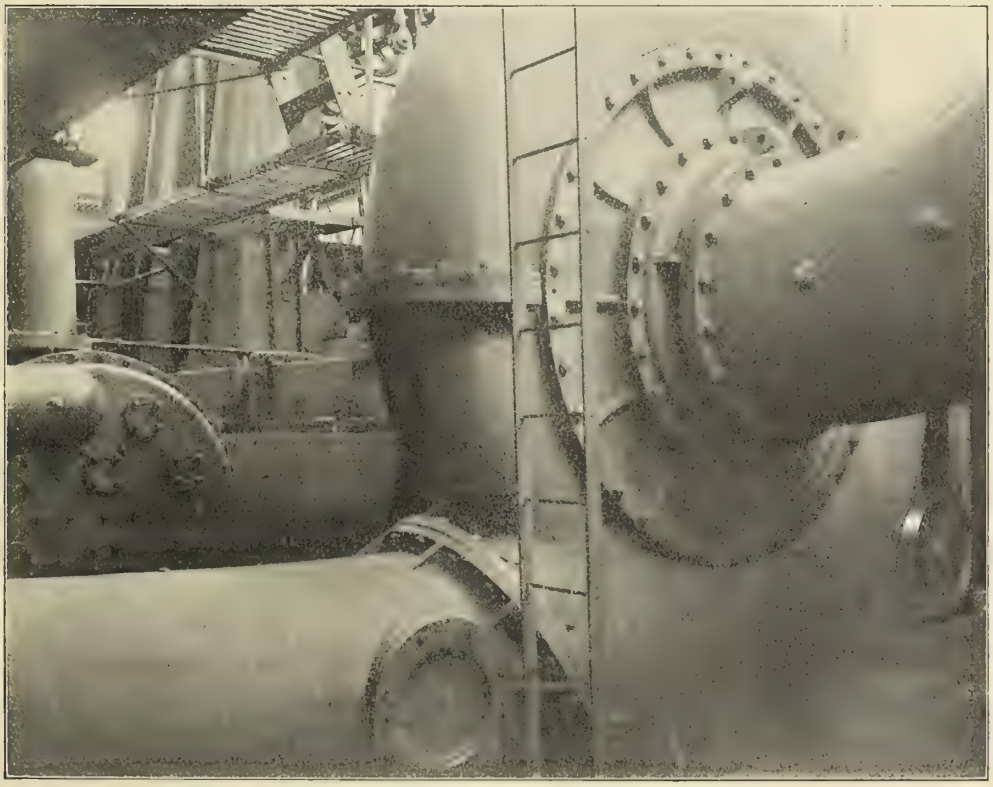
HYDRAULIC DREDGE J. ISRAEL TARTE.



DECK PLAN AND INBOARD PROFILE OF THE HYDRAULIC DREDGE J. ISRAEL TARTE, BUILT AT THE POLSON IRON WORKS, TORONTO, ONTARIO, A. W. ROBINSON, CONSULTING ENGINEER.



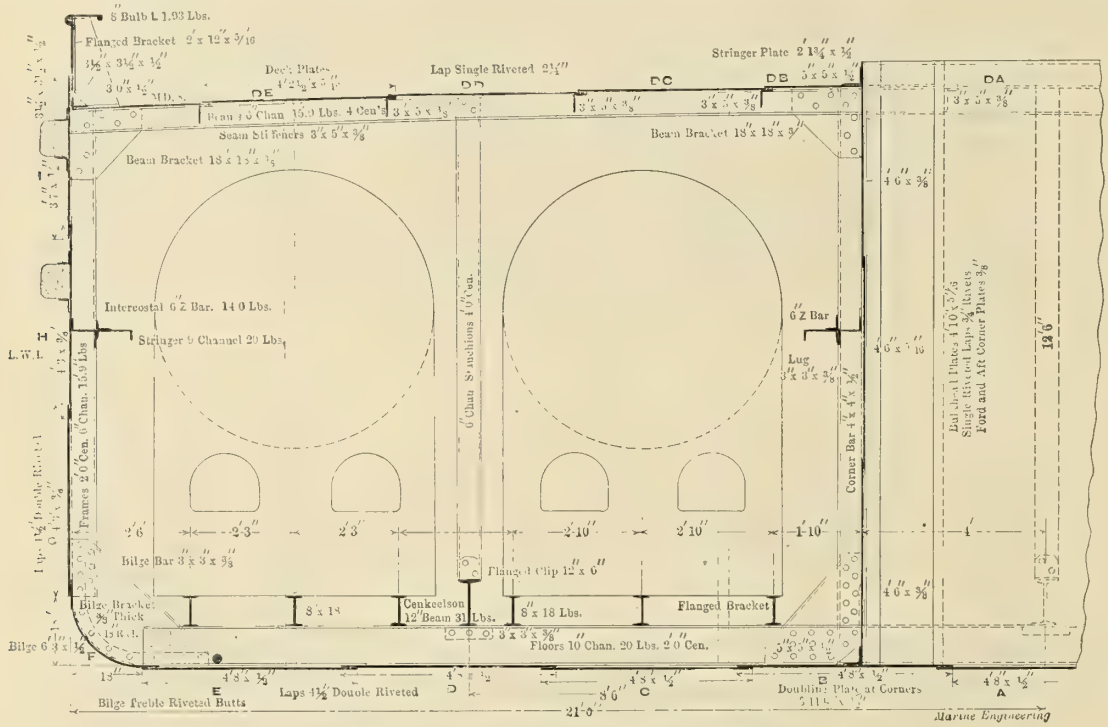
WINCH FOR CONTROLLING THE SUCTION ARM.



ENGINE ROOM AND MAIN SUCTION PUMP, HYDRAULIC DREDGE J. ISRAEL TARTE.

such as rock, should be encountered no breakage will occur—the engines will simply stop, all the working parts being strong enough to stall the engines. The dredge is to be used for deepening the St. Lawrence river, where it will encounter nothing but sand.

The great advantage of this type of dredge over any other for this work is that it transports and discharges all the dredged material at one operation without the use of scows or tugs with their attendant expense and interruption. In fact, it would be extremely difficult to provide sufficient scows and manipulate them fast enough to remove the large amount of material which this machine is capable of dredging. Its operation is continuous and uninterrupted, the material being discharged through a series of floating discharge pipes with flexible connections. These pipes are 36 inches


8 Bulb L 1.93 Lbs.
Flanged Bracket 2' x 12" x 5/16
Deck Plates
Lap Single Riveted 2¼"
Stringer Plate 2' 1¾" x ½"
Beam 6 Chan. 15.0 Lbs. 4 Cen's
Seam Stiffeners 3" x 5" x 5/8"
Beam Bracket 18" x 18" x ½"
Beam Bracket 18" x 15" x ½"
Intercostal 6" Z Bar. 14.0 Lbs.
Stringer 9 Channel 20 Lbs.
6" Z Bar
Lug
Frames 2'0 Cen. 6 Chan. 15.0 Lbs
6 Chan Stanchions 1'0" Cen.
Corner Bar 4" x 4" x ½"
Bilge Bar 3" x 3" x 5/8"
Flanged Clip 12" x 6"
Bilge Bracket 5/8" Thick
Cenkeelson 12" Beam 31 Lbs.
8" x 18 Lbs.
Flanged Bracket
Floors 10 Chan. 20 Lbs. 2'0 Cen.
Laps 4½" Double Riveted
Bilge Treble Riveted Butts
Doubling Plate at Corners
21'-6"
Marine Engineering

MIDSHIP SECTION OF CANADIAN-BUILT HYDRAULIC DREDGE.

diameter, and when coupled up form a line 2,000 feet long. The pipe and its two floats are built in sections 100 feet long, all of steel. The center one is the discharge pipe for carrying away the dredged material, and is supported by a water-tight air chamber or float on each side. The discharge end of the pipe is carried over a large scow, which is anchored in position where required, and is able to feed itself along, as the dredge progresses, by means of a steam winch.

The motive power consists of a set of triple-expansion engines having cylinders 20, 31, and 50 inches diameter by 25 inches stroke, of 1,200 H. P., which drive a large centrifugal pump. This pump is of special construction for the work, being designed for great efficiency and so that it will not clog even with large masses of solid matter. There are four boilers of the locomotive type, each 74 inches diameter, 31 feet long, having collectively 6,000 square feet of heating surface, built to pass government inspection for 160 pounds working pressure, and fitted with the Sturtevant system of induced draft automatically regulated by the steam pressure in the boilers.

The movements of the dredge are controlled by powerful steam winches at either end, by which the vessel is moved at any desired rate and under perfect control at any time. Commodious quarters for the officers and crew are provided both on the main and upper decks. There is a complete electric installation, so that the dredge can work night and day.

The full capacity of the plant is 10,000 cubic yards mixed material (sand and water) or 2,000 cubic yards solid matter per hour. This dredge is an entirely Canadian production. The Polson Iron Works not only built the hull, but also the main pump, triple-expansion engines, boilers, pontoons, and pipe connections, at a cost of over $250,000, and, in fact, handed the plant over complete and in full operation to the Minister of Public Works in Toronto bay. Since the vessel has been doing her work upon the channel of the St. Lawrence river, the company has received congratulatory reports of her behavior from the Deputy Minister of Public Works at Ottawa. Associated with the firm as consulting engineer for this vessel was Mr. A. W. Robinson, M.E., C.E., Montreal.

Owing to the steady increase of business, the Polson Iron Works recently increased the area of its premises by reclaiming an additional four acres of land from Toronto bay, thus obtaining altogether 2,100 feet of water frontage. At the same time the company rebuilt and re-equipped its wood-working and pattern-making shops, as well as the smithy, and these are fully up to date as regards machinery, heating, and lighting. The largest planing machine and boring mill

in Canada have just been installed in the machine shop, and the shipyard has been equipped with a new modern overhead traveling gantry built upon the same principle as that at Harland and Wolff's, Belfast. This gantry will handle all the material required in the largest ship that can ever be constructed in the yard, being 75 feet span, 60 feet high, and having a capacity of 10 tons. A pair of 50-ton shear legs, operated by electricity, is erected on the water front, for lifting heavy machinery on or off ships under construction or repairs. The premises throughout are equipped with steam, pneumatic, and hydraulic power, and, in view of a continuation of good business prospects, further additions to the plant and premises are contemplated in the immediate future. J. W. M.

street immediately in the rear of the Engineers' Club's property.

Mr. J. C. Kafer, president of the Engineers' Club, and Mr. John Fritz, the venerable ex-president of the American Society of Mechanical Engineers, then saw Mr. Carnegie and received from him a ready promise of a million dollars or more for the erection of one central building for the use of all the societies. It is understood that the societies shall raise the money for the purchase of the land.

Thus it appears that the long-projected plan is to be consummated, and it is to be hoped that the building will be as great a success in meeting the demands of the constituent societies as has been American engineering work in other fields.

DECK VIEW ON HYDRAULIC DREDGE.

Mr. Carnegie's Offer for an Engineering Building.

The subject of housing the several large engineering societies of New York city under one roof has often been under discussion, as the many advantages of such a move were generally realized. About a month ago Mr. Andrew Carnegie offered $1,000,000 toward the erection of such a building, and steps are now being taken by a committee of the societies to formulate a general plan and secure a vote on this question from their respective societies. The committee consists of fifteen, made up of three from each, namely: American Society of Civil Engineers, Society of Mechanical Engineers, the American Institute of Mining Engineers, the American Institute of Electrical Engineers, and the Engineers' Club.

The Engineers' Club recently purchased two lots on the south side of Fortieth street, between Fifth and Sixth avenues, and options have just been secured on five contiguous lots on the north side of Thirty-ninth

Reorganization of Cramp Company.—A loan of $7,500,000 has been advanced to the William Cramp and Sons' Ship and Engine Building Company by the depositing of stock of the company with the bankers representing the Morgan interests. The reorganization means that the shipyard is completely under the control of the new capitalists. Edward J. Stotesburg, Richard A. Rushton, George F. Baker will have charge of the finances of the company, as they were elected at the directors' meeting as voting trustees of the corporation. The old directors presented their resignations, but no action was taken. More than 50 per cent. of the Cramp stock has been deposited with Drexel and Company, thus consenting to the plan of reorganization. Stockholders of the company will vote on June 25 on the matter of increasing the capital from $5,000,000 to $6,000,000 and the bonded debt from $1,800,000 to $7,500,000.

MARINE ENGINE DESIGN—COMPARATIVE PRACTICE, 1903.

BY JOHN CALDER.

In reviewing the field of marine engineering at the present date the most comprehensive grasp of the situation is obtained by arranging an analysis according to a quantitative function of the engine performances, which has invariably increased with the successive problems solved during the last fifty years, viz.: piston speed.

The demand for greater power has been met in several ways:

1. Increasing cylinder diameter.
2. Increasing cylinder stroke.
3. Increasing steam pressure.
4. Increasing revolutions.

1. Was the only means at disposal during the period of the horizontal athwartships marine engine and the unit of power was not reduced in cost.

2. Became practicable when the inverted engine was introduced and effected some reduction in weight, in cost, and in engine stresses.

3. Was long delayed owing to the slow progress of the boiler-making art during the first half of the above period and the lack of reliable materials for the higher stresses.

4. Commended itself from the first to the most observant marine engineers as the most economical of all methods of increasing power, and over the whole period there has been a steady rise of piston speed and speed of revolution as a result of growing experience in designing free ports and steam passages and the balancing and efficient lubrication of reciprocating and rotating parts of the engine.

At the same time there has been a steady reduction in the weight of the machinery and boilers per unit of power, and likewise in the cost. As the various steam-propelled craft became more and more specialized, the marine engineer was confronted with the task of securing highest speeds in each class on vessels of narrowly restricted dimensions and displacement, and was called upon to pack away the propelling apparatus in smaller and smaller compass per unit of power.

This problem, when faced in the most economical way, brought piston speed to the front as the determining factor, and its successive increases are landmarks in marine engineering progress. The cut on page 315 shows the growth in this respect during fifty years of a steam navy in which machinery space is always a compromise between the conflicting demands of armor and guns, and of a steamship company which demands a reasonable surplus-paying displacement in its fast vessels. It will be noted that both have progressed together throughout the whole period, and they are typical of the demand for higher piston speeds in all maritime countries.

First-class battleships and cruisers and the fastest merchant steamers to-day run at the same piston speed, 950 feet per minute, and the more remunerative intermediate service has alone restricted the number of the fast liners.

Leaving out of consideration some very small or very special craft, such as launches, small coasters, tenders, and tugs, there are seven main classes of service for which the marine engineer has to design appropriate propelling machinery, and within each of which he has to attain increase of power with reduction of unit weight in the case of the faster vessels in the group. These services are:

1. Side-wheelers.
2. Freighters.
3. Freight and passengers.
4. Passengers and mails.
5. Channel and sound express boats.
6. Battleships and cruisers.
7. Torpedo-boat destroyers and scouts.

The machinery particulars of such craft have been graded in the tables according to piston speed, and a glance at the data will show how systematically the designer has resorted to a higher rate of working when called upon to supply greater power with reduced unit weight.

1. *Side-Wheel Steamers.*—The heaviest machinery weight and space demand per unit of power is made by river and sound craft using the slow-revolution, simple or compound beam engine with cylindrical boilers and large, non-feathering wheels. The outfit is consequently expensive and entails also a greater displacement and size of vessel; on the other hand a very simple, easy-running machine is obtained.

Where first cost is a determining factor, or where speed results have to be obtained on a vessel whose length and draft are restricted by shoal water or limited manœuvering area on the surface, a substantial reduction in the weight per unit of power is imperative and the heavy beam engine has to be dropped. With the necessary advance in piston speed the two-cylinder compound inclined engine of specially strong materials and with small diameter, broad feathering wheels is introduced, using 100 to 120 pounds of steam, with light surface condensers of small capacity, moderate vacuum, and a uniform cylinder ratio of 1:3.5. In the higher-powered engines of this class forced draft is invariably used, and 11 I. H. P. per ton of weight has been attained by substituting the locomotive type of boiler. Where over 4,000 I. H. P. is demanded the size of the cylinders is inconvenient and a three-cylinder compound or triple type is used.

On long runs three-cylinder, triple-expansion, inclined engines are always used to reduce coal consumption and bunker space, and with 160 pounds steam give 10 I. H. P. per ton. A speed of 22 knots has been attained with 8,000 I. H. P. on a vessel 340 feet long, 38 feet beam, 8 feet 11 1-2 inches draft, and of about 1,515 tons displacement. In the numerous seagoing channel steamers of this type the paddle wheels receive severe usage and their reinforcement for stormy routes reduces the I. H. P. per ton to 9. The seagoing high-speed craft of this type are being gradually replaced by class 5.

2. *Freighters.*—This class of vessel has increased considerably in dimensions during the past decade and embraces all types of cargo carriers, from the modest 300-foot tramp, carrying 4,000 tons deadweight, which can trade in all waters, propelled by the regulation three-cylinder, triple-expansion engine, ratios 1:2.65:7.1, under 175 pounds steam, to much larger and more fully equipped twin-screw freighters on regular service be-

MARINE ENGINE DESIGN—COMPARATIVE PRACTICE, 1903.

PISTON SPEED. FT. PER MIN.	CLASS OF STEAMER.	SPEED OF STEAMER IN KNOTS.	MACHINERY PARTICULARS. PROPELLER.	TYPE OF ENGINE.	CYLINDER ARRANGEMENT.	CYLINDER RATIO	BOILERS.	PRESS. LBS.	DRAFT	TYPICAL MODERN VESSELS.	I. H. P. PER TON OF PROPELLING MACHINERY VIZ.: ENGINES, BOILERS, AND WATER.
	(1) PADDLE.										
400	River Paddle Steamer	13 to 15	Side wheels.	Inclined	2 comp. side by side	1 to 3.5	Cyl.	100	Nat.	.....	6.50
500	" " "	15 to 18	" "	"	" "	" "	"	110	Forced	Duchess of Hamilton.	7.22
600	" " "	18 to 22	" "	"	" "	" "	Loco.	120	"	Koh-I-Noor (Thames service).	11.00
700	" " "	18 to 22	" "	"	3 triple side by side	1:2.16:4.85	Cyl.	160	"	Lord Warden (Calais-Dover).	10.00
700	Sea Paddle Steamer... (Heavier paddle wheels required).	18 to 22	" "	"	" "	" " "	"	160	"	Leopold II. (Ostend-Dover route).	9.00
	(2)										
530	Ordinary Freight, 300 to 450 ft.	9 to 11	Single screw.	Inverted.	3 triple.	1:2.65:7.1	Cyl.	175	Nat.	Indrani and Californian.	4.85
530	" " "	11 to 13	" "	"	" "	"	"	200	Forced	Burma.	6.00
600	" " "	11 to 13	Twin screw.	"	" "	"	"	200	"	Nevadan and Mississippi.	5.85
600	" " "	11 to 13	" "	"	4 quad.	1:2.1:4 5:9.14		214	"	Texan.	5.48
	(3)										
700	Intermediate Steamships, 450 to 600 ft.	13 to 16	Twin screw.	Inverted	3 triple	1:2.65:7.1	Cyl.	200	Forced	Rimutaka.	5.12
750	Very large Intermediate Cargo and Passenger, 600 ft. and over.	14 to 16	" "	"	4 quad.	1 2 07:4.24:8.82	"	214	Assisted.	Celtic and Minnehaha.	4.37
	(4)										
800	Passengers and Mail.	16 to 19	Single screw.	Inverted.	3 or 4 triple.	1:2.65:6 38	Cyl.	160	Nat.	Lahn.	7.00
800	" " "	16 to 19	Twin screw.	"	" "	"	"	"	Forced	Teutonic.	6.00
950	" " "	19 to 22	" "	"	4 triple.	1:2.07:6.87	"	175	Nat.	Lucania.	6.16
950	" " "	19 to 22	" "	"	3 quad.	1:2.08:4.16:8.71	"	220	"	St. Paul	5.95
950	" " "	19 to 23	" "	"	" "	"	"	"	Forced	Deutschland.	6.25
	(5)										
880 to 910	FAST CHANNEL AND SOUND STEAMERS.	17 to 22	Twin screw.	Inverted.	4 triple.	1:2.28:5.84	Cyl.	160	Forced	Sandy Hook and Arundel.	8.00 to 9.70
	(6)										
950	BATTLESHIPS AND CRUISERS, 1ST CLASS.	20	Twin screw.	Inverted.	4 triple.	1:2.66:7.00	Cyl.	175	Nat.	.....	8.50
950	" " "	23	" "	"	" "	"	"	"	Forced	H. M. S. Minerva.	11.02
950	" " "	23	" "	"	" "	"	Water-tube.	250	Nat.	H M. S. King Alfred, Louisiana, and Express.	12.00
	(7)										
1,200	TORPEDO BOAT DESTROYERS & SCOUTS.	30	Twin screw.	Inverted.	4 triple.	1:2.36:5.50	Yarrow Water-tube.	250	Forced	Decatur.	41.00
Mean peripheral velocity of high-pressure vanes.	TURBINE-DRIVEN VESSELS.				NUMBER OF EXPANSIONS						
5,700	Turbine River Steamer and Turbine Steam Yachts.....	15 to 20	Multiple screw, 3 shafts, 5 screws.	3-cylinder, 1 H.P., 2 L. P., Hor. Comp. Parsons Turbine	125	Cyl.	150	Forced	Queen Alexandra, Emerald, and Lorena.	12.00
6,000 (Estimated)	Turbine-driven Atlantic Liner, Pass. and Mail, or Battleship or Cruiser.....	23	Multiple screw, 4 shafts, 8 screws.	2 sets of 2-Cylinder Hor Comp. Parsons Turbine.	135	W. T.	160	"	Superheated Steam.	16.00
6,200	Turbine-driven Pass. and Mail Channel and Sound Steamer.	25	Multiple screw, 3 shafts, 5 screws.	3-Cylinder Hor. Comp. Parsons Turbine.	125	"	170	"	Calais-Dover Packets (Building)	20.00
7,000	Turbine-driven Torpedo-Boat Destroyer and Scout, also very fast Yachts.....	25-32	Multiple screw, 3 shafts, 9 screws.	3-Cylinder Hor. Comp. Parsons Turbine	"	"	"	"	H. M. S. Velox and Tarantula.	55.00
10,000	Turbine Destroyers of maximum speed....	36	Multiple screw, 4 shafts, 8 screws.	2 sets of 2-Cylinder Hor. Comp. Parsons Turbine.	"	"	"	"	Viper.	70.00
8,000	Small 44-ton displacement experimental vessel, low coal radius and few auxiliary fittings.....	32	Multiple screw, 3 shafts. 9 screws.	3-Cylinder, 1 H.P., 1 I.P., 1 L.P., Hor. Triple Parsons Turbine.	150	"	150	"	Turbinia.	100.00

tween deep-water harbors. The piston speed is 530 feet per minute, rising to 630 feet in the bigger engines.

As a rule the smaller tramps are still single-screw, and quite a number of the 8- to 10-knot vessels use natural draft. The larger 10- to 13-knot twin-screw types, however, have usually closed ashpit draft, and on long runs four-cylinder, quadruple-expansion engines are fitted to work at a piston speed which brings the machinery weight per unit of power well up to the corresponding single-screw figures, viz., 6.00 I. H. P. per ton.

The great majority of purely freight steamers launched in any one year throughout the world are engined with a more or less stereotyped single-screw triple engine of from 1,200 to 2,200 horse power, with auxiliaries and pipe arrangement similar to the detailed example given in the February issue of MARINE ENGINEERING. Owners of numbers of this type of vessel, which is the simplest case the engineer has to consider, are naturally conservative and progress is generally determined by the necessities presented to the designer by other and more difficult problems.

The economical production of moderate-sized freighters, with the minimum scantling and machinery equipment which will secure registration, has become the staple trade of many yards on the Lakes, the Clyde, and the east coast of England, where ship and engine building is highly specialized.

In the limited number of oil-carrying freighters oil fuel is now well established, but it is as yet barely introduced in the regular cargo service.

3. *Freight and Passenger Vessels.*—The most marked development in remunerative shipping enterprise has been seen during the last three years in this class of vessel, which has a much larger paying freight displacement than the first-class ocean liners, and, owing to the moderate speed sought, and to the fact that resistance to propulsion per ton of displacement steadily reduces with increase of bulk, its machinery space is relatively much smaller. The designer is therefore able to equip such craft with a fairly heavy type of four-cylinder, quadruple-expansion engine (ratios 1 : 2.07 : 4.24 : 8.82), which is now invariably twin screw and runs at a piston speed much lower than the faster craft.

In consequence the weight per unit of power is larger than any of the table, the result being durability of parts and freedom from accident. The *Celtic* and *Cedric* represent the largest vessels of this class, in which the fine vessels of the Atlantic Transport Line, the intermediate Cunarders, and the ships building at New London are smaller but excellent examples. On one of the Cunarders, the *Saxonia,* the British Admiralty tests of last year proved conclusively the remarkable efficiency of the Scotch boiler when moderately steamed as it is in such craft.

4. *Ocean Liners.*—These vessels, of enormous power, have practically reached their maximum performance as to the weight of the unit of power, viz., 6.25 I. H. P. per ton. At least this is so for reciprocating engines, and the new Cunarders will excel in bulk, but will probably not differ much in engineering features from the German vessels. Running at the piston speed of a battleship, their twin-screw, six- or eight-cylinder, quadruple-expansion engines and boilers represent the acme of marine engineering attainment, and leave but one-tenth, and, in the very largest craft, one-twentieth, of the vessel's capacity as paying displacement for valuable express freight. In the new and faster liners referred to there is every probability that this small margin will vanish altogether.

The result of the efforts being made at the present moment to attain reasonably low revolutions from marine steam turbines of high power will materially affect the future progress of the fast liner. Until then the financial risk is too great an undertaking, as it is well known to those who have had experience in turbine propulsion that the propeller, not the turbine, efficiency of high-speed craft is the weak point.

5. *Fast Channel and Sound Screw Steamers.*—This class of vessel, with inverted screw engines, has become the rival of the side-wheel steamers of the same speed and service, and on many railroad sea connection routes has already displaced the latter. The position of the former prime movers is in turn being assailed by the multiple-screw steam turbine.

The greater efficiency of the screw in comparison with the paddle wheel, and the possibility of using it in twin form on the shoal waters of terminals, for which the shallow-draft side-wheeler was formerly the only solution, have made it possible to supply the unit of power for the same weight. Additional advantages are gained at the same time in getting rid of heavy feathering paddle wheels liable to severe damage in rough weather, and in the safety secured by duplicate sets of inverted four-cylinder, triple-expansion engines in place of single sets of triple-inclined engines.

The manœuvering power of the screws is fully as good and the coal bill is also favorable. The vessels of this class are very fine examples of naval architecture and in machinery and fittings are practically miniature Atlantic liners. Their runs, however, being limited to from 20 to 60 miles, a considerable reduction is made in the auxiliary machinery equipment, and the lower cylinder ratios, 1 : 2.28 : 5.84, enable the unit of power to be obtained for 33 per cent. less weight than in the liners.

As length and draft are almost invariably fixed in this class of service by terminal conditions, every aid that tank experiments could give toward the best form of hull and propeller has been necessary, and the best result (1900) attained with reciprocating machinery during the last decade is that of the English channel steamer *Arundel,* 269 feet long by 34 feet beam by 8 feet 10 inches draft, on the New Haven-Dieppe route. This steamer, of about 1,020 tons displacement, attained 22 knots with 5,000 I. H. P., which is a reduction of 71 feet in length of vessel and of nearly 40 per cent. in I. H. P. for the same speed and practically equal deadweight capacity in the best attainable side-wheel results for such service.

6. *Battleships and First-Class Cruisers.*—In the engineering of these vessels coal economy and consideration of first cost of material are waived in favor of small bulk. The result is that on the same piston speed as the ocean liners a lighter and quicker revolution engine is built, and with cylinder ratios 1 : 2.66 : 7.00, natural-draft cylindrical boilers, and 175 pounds steam pressure, yields,

in the older and nearly obsolete types, 8.5 I. H. P. per ton of machinery. This result is increased to 11.2 I. H. P. with forced draft not exceeding 1 inch water gage, and, with water-tube natural-draft boilers of 250 pounds pressure, reaches 12 I. H. P. per ton, or nearly double the best liner results.

Of course such power results cannot be maintained with anything approaching the certainty and duration of the corresponding mercantile craft, but, as a marine engineering problem, such warship engines present many interesting and difficult questions to the designer for solution.

7. Torpedo-Boat Destroyers and Scouts.—In these high-speed vessels of low coal radius almost all the free displacement is devoted to propelling machinery, and the unit of power for reciprocating engines is obtained with less weight than in any other problem presented to the engineer.

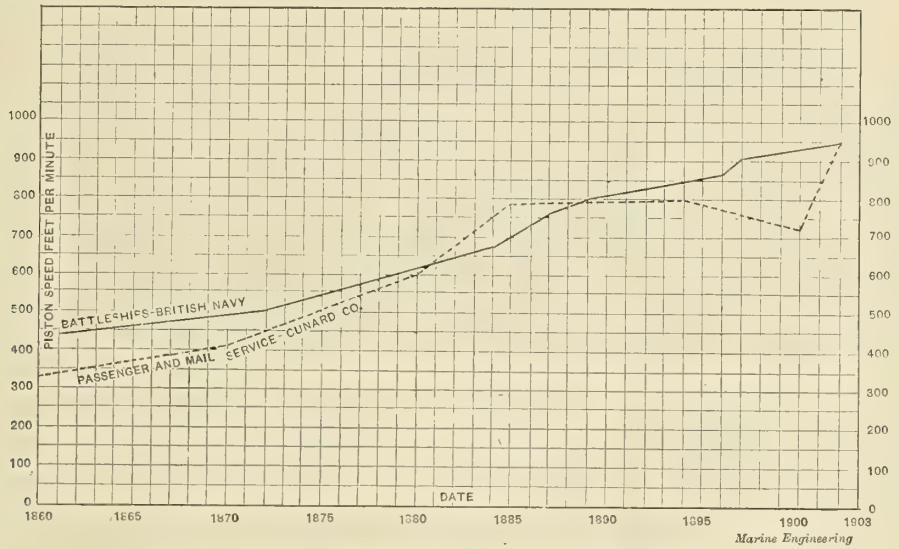
Coal economy is still less regarded than in the larger naval craft, though in both it is now subject to definite restriction, and the light water-tube boilers, usually Yarrow type, are forced to the fullest extent. In an even greater degree than the larger war craft all machinery weights are curtailed, and the working stresses of the strongest materials obtainable are carried to the maximum limit.

Under such conditions 41 I. H. P. per ton is obtained with great care in the operation of the machinery. The risks involved in running such craft are now being lessened somewhat by the reduction of the speed demand to a limit of 25 knots, which can be maintained for some hours, and the raising of both hull and engine scantlings will increase their seaworthiness and usefulness.

Turbine-Driven Vessels.—The seven classes of service just considered embrace the great bulk of the marine designer's work with reciprocating machinery, but the practicability of the marine steam turbine, and the adaptability of the screw propeller to the new conditions introduced by a great and sudden advance in the revolutions, have, within the last two years, considerably altered the engineering outlook.

Turbine screw propulsion has come to stay, and the question to be settled shortly is its range of economical application. It has been successfully substituted for reciprocating machinery in the smaller fast passenger steamers, with saving of weight and fuel, in steam yachts, and in the smaller war craft with speeds ranging from 15 to 36 knots. It will be seen from the table that its unit of power is obtained for decreased weight proportional to the mean peripheral velocity of the high-pressure turbine vanes which are analogous to piston speeds. This increase is obtainable by using larger turbines, or by increasing the revolutions, or both; but if the machine is made larger the unit of power will remain stationary as to weight and may even increase.

The table shows that the new prime mover is fully as flexible for varying conditions as the older, and produces from 12 I. H. P. to 100 I. H. P. per ton of machinery. Consequently in all services where low machinery displacement is essential, such as Nos. 1, 5, and 7, the weight ratios of 12, 20, 55, and 70 compare favorably with the 9, 97, and 41 of reciprocating practice. We may soon expect to see the turbine installed on the larger fast craft of both services.



CURVE OF PISTON SPEEDS DURING THE LAST FORTY-THREE YEARS.

Six-Masted Schooner Addie M. Lawrence.

The new type of six-masted schooners can no longer be termed an experiment, but a practical and successful vessel. The latest acquisition to the fleet is the *Addie M. Lawrence,* recently built and launched on December 17, 1902, from the same ways which the *Eleanor A. Percy,* the largest wooden sailing vessel in the world, had occupied at the yard of Percy and Small, Bath, Me. Although she is practically a duplicate of the *Percy* in construction, her dimensions are much smaller, and as measured by the custom house officials are, 292.4 feet on keel, 48.3 feet beam, and 22.3 feet depth of hold, while the gross tonnage is 2,807 and the net 2,195.

The greatest care was exercised in the selection of the material for her construction, and none but the best woods have been used. There is a two-tier keelson of birch and maple, measuring 13 by 15 inches; the main keelson is six-tiered, 14 by 14 inches, while the three

tiers of sister keelsons on each side are of the same dimensions.

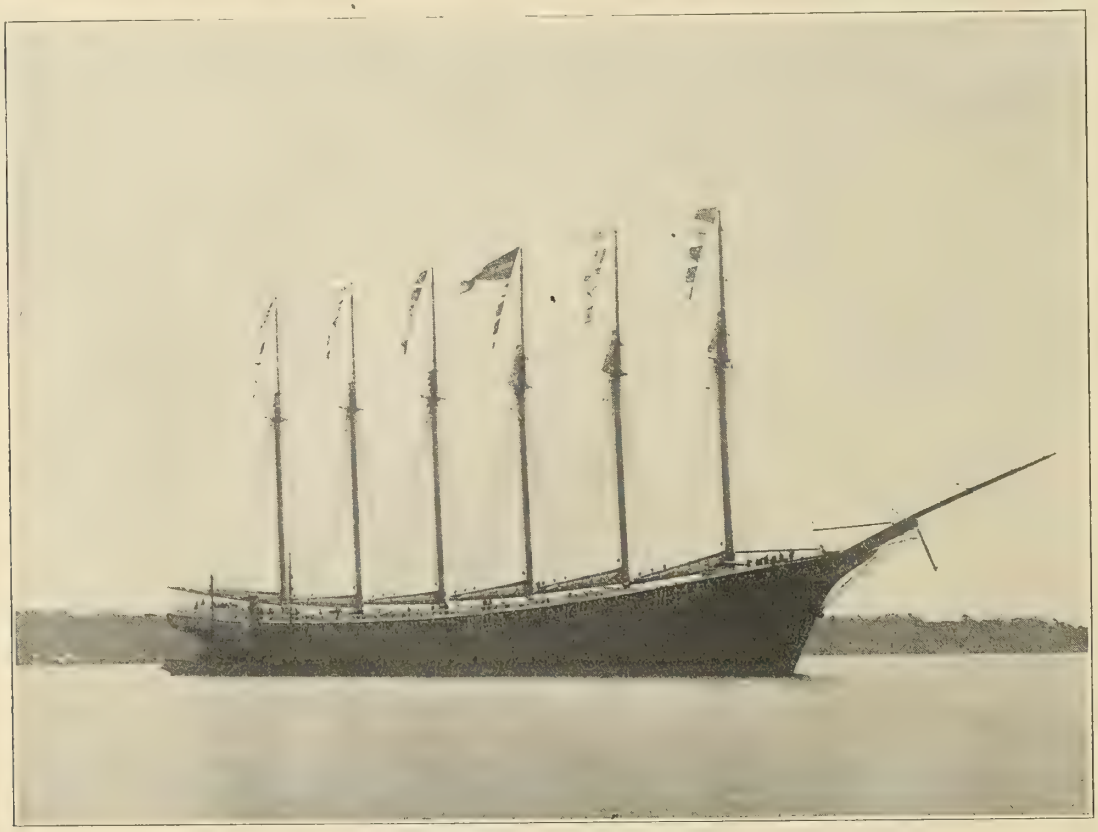
The stern post is of white oak, sided to 21 inches, and the inner post, stem, and apron are of the same material. There are 94 frames, and 10 cants aft, all of hard wood with hackmatack tops. The ceiling from the hanging knee strake to the keelson is 17 strakes wide, of yellow pine measuring 12 by 14 inches, between the decks it is 14 by 14, and the poop-deck ceiling is 8 inches through.

There are two and one-half decks, of yellow pine. The lower-deck beams are 13 by 13 inches. The two lock strakes to the lower hold are 13 by 13 inches, locked down over beam. There are three hanging knee strakes 14 by 14 inches, then two ceiling strakes 9 by 14 inches and two clamp strakes of the same dimensions. The main-deck beams are 9 by 13 inches, while the main rail is 6 by 15 inches, and there are three lock strakes, 10 by 13 inches, locked over the beam. The poop, which runs forward almost to the foremast, has beams 8 by 13 inches, with one main rail, two lock strakes, 8 by 12 inches, locked over beam. The planking is yellow pine, the garboard being 8 by 14 inches, while the main runs from 14 inches on the bottom to 6 inches on the gunwale. All the fastenings are of locust treenails and galvanized composition bolts with iron butts. On account of her great length and size, she is securely strapped on each side with steel bands measuring three-quarters of an inch in thickness and 12 inches wide. There are five discharging hatches on the main deck, each being 12 by 16 feet in the clear.

In the selection of materials for the masts, the utmost care was taken in securing the most perfect specimens of Oregon pine for the lowers, all of which are 118 feet in height and 30 inches in diameter at the base, with the exception of the foremast, which is 33 inches. The foretopmast is Oregon pine, 55 feet long and 20 inches in diameter, while the rest are of spruce, the same length, but only 16 inches in diameter. The gaffs and booms are also of spruce. All the rigging is of wire set up with turnbuckles, an idea which originated with the builders of the *Lawrence*, and she carries nearly 8,700 yards of the best quality duck sails.

There are three deck houses. The aft cabin, measuring 29 by 35 feet, comprises the captain's suite of rooms, the mate's private room, a bath room, dining and reception rooms, guest's room, closets, etc. It is finished in quartered oak, mahogany, and cypress. The pilasters and panels are mahogany, doors and stiles quartered oak, and the ceiling of both compartments of cypress, while the floors are of natural hard-wood finish. The aft compartment is decorated in black and gold and the forward in black and aluminum, the combinations formed being very beautiful. All the furniture is upholstered in leather, and the plumbing is of the open-work type. The midship house is 20 by 27 feet, finished in South Carolina pine, and comprises the galley, steward's and second mate's rooms, mess room, a large carpenter shop, and sail room. In the forward house, which is 22 by 29 feet, is the engine room, engineer's room, and the forecastle.

A complete steam equipment for handling the ship



SIX-MASTED SCHOONER ADDIE M. LAWRENCE.

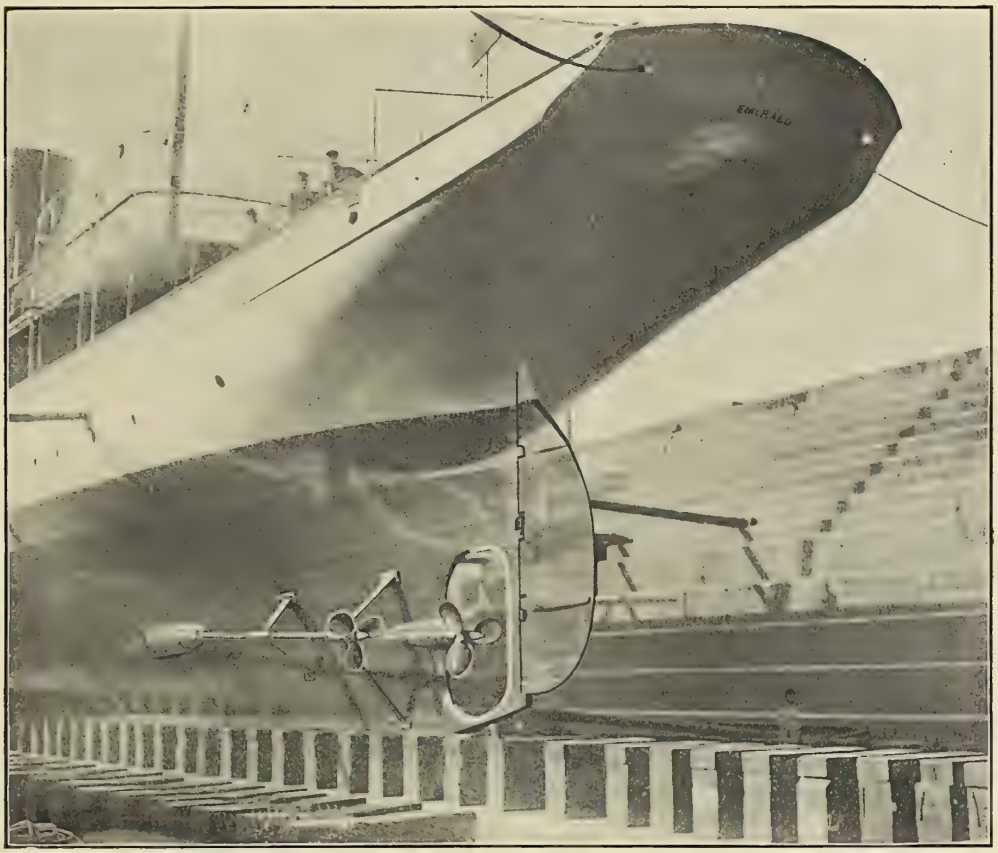
and cargo is installed. All the machinery aboard was furnished by the Hyde Windlass Company, of Bath, Me. It includes a No. 12 double-geared messenger attached windlass for handling a 2 1-2-inch standard chain, fitted with Hyde patent riding stoppers, and a winch head on the forecastle deck having direct connection to the windlass. This is connected by messenger chain to a 6 1-2 by 10-inch hoister, and steam is furnished by a 56 by 90-inch boiler. The craft also has two duplex pumps for feeding the boiler, washing down decks, etc., the dimensions of one being 4 1-2 by 2 3-4 by 4 inches, and the other 5 1-4 by 4 3-4 by 5 inches. She also has two 7 1-2 by 8 1-2 by 6-inch Hyde duplex wrecking pumps, one being located forward and the other aft. In addition to these is a set of 6-inch Adair pumps, also a 6 by 8-inch horizontal hoister aft. She also has a No. 10 Robinson steerer with a mahogany steering wheel and a No. 4 Hyde power capstan. Small winches are placed at the cargo hatches. Steam is supplied by means of a large boiler in the engine room. There are two stockless anchors, each weighing 8,500 pounds and attached to 240 fathoms of 2 1-2-inch chain. A 27-foot lifeboat is fitted with a 5 horse-power gasoline engine. There is also a 17-foot dinghy.

The *Addie M. Lawrence*, owned by J. S. Winslow and Company, Portland, Me., is the fifteenth vessel built by Percy and Small, and represents a cost of nearly $130,000.

Turbine Yacht Emerald.

The first turbine-propelled English-built yacht has recently arrived in the waters of New York bay after a stormy passage from the Clyde. The vessel is chartered from the owner, Sir Christopher Furness, to Mr. George J. Gould, and is now under command of Captain Tod. In reporting on the trip the captain says that although very heavy gales and seas were encountered he kept his yacht on the course the entire time and that she is a good sea boat.

The *Emerald* is 236 feet long, 18 1-2 feet deep, 28 feet 3 inches beam, and is driven by three Parsons turbine engines, each mounted on a separate shaft. As designed, the outboard shafts each were fitted with two propellers; but as it was found that the forward propellers on the wing shafts were not sufficient, these were taken off before crossing the Atlantic. The yacht was built at the works of Alexander Stephen and Sons, Ltd., Scotland.



STERN VIEW OF THREE-SCREW, TURBINE-PROPELLED YACHT EMERALD.

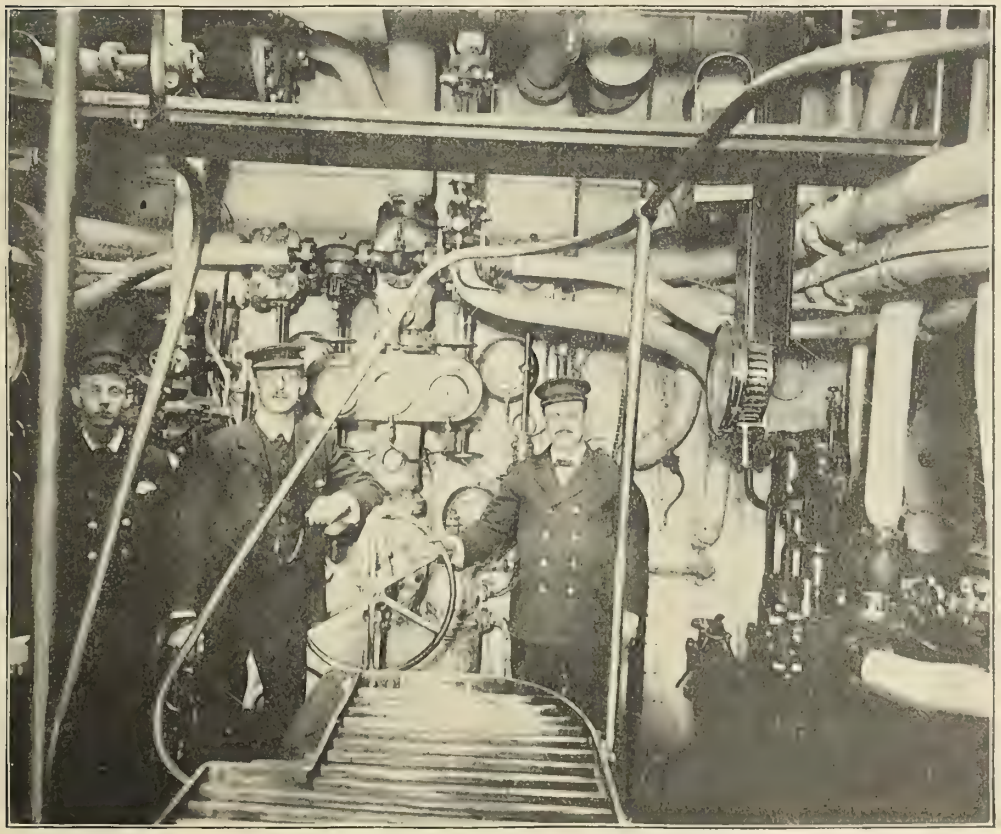
Wreck of the Schooner Charles L. Davenport.

During a thick fog on March 30 on Chesapeake bay the four-masted schooner *Charles L. Davenport* ran ashore at 5 A.M. off Old Point Comfort Light, about one hundred yards from the masked batteries at Fortress Monroe. The schooner was built in 1890 by Washburn Brothers, of Thomaston, Me., and was of 1,032 gross tons. She was owned by C. H. Washburn and commanded by G. Samuel Watts. Up to the present time no attempt has been made to move her.

ENTRANCE HALL.

DECK SMOKING ROOM, TURBINE YACHT EMERALD.

OWNER'S STATE ROOM.



ENGINE ROOM, LOOKING FORWARD, TURBINE YACHT EMERALD.

Marine Engineering

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Notice to Advertisers.

Changes to be made in copy, or in orders for advertisements, must be in our hands not later than the 15th of the month, to insure the carrying out of such instructions in the issue of the month following.

THE American who reads in his daily paper, whether he be a capitalist or a union laborer, the almost innumerable accounts of strikes, lockouts, or boycotts now going on in almost every State in the Union, cannot but wonder what is to be the result of all this, and what is the cause of so much labor agitation at the present day. While it is neither the intention nor province of this paper to deal with labor questions, so seriously are they menacing the shipbuilder and shipping interests of this country that we ask our readers to pause for a moment and consider one or two fundamental principles. We must recognize that the inalienable right of every American citizen is to sell his labor where and as he chooses; that if he does not like his employer he has a perfect right to seek other employment; but never has he been given the right to prevent other men, whether or not in the union, working in his place. If the latter were true and the principle recognized in our law, then this country would be a despotism equal to any of the European sovereignties. It is true that the unions have been of advantage to the workingman, and we believe that labor should be organized as well as capital; but the two organizations should work together, for neither can succeed without the other, and the success of one brings success to the other.

Questions will always arise between employer and employee, but these should be subject to adjustment. When either side refuses to arbitrate it is fair to assume that that side is in the wrong. It is unusual for the labor organizations to refuse arbitration, yet this was the case up to the last moment with the striking engineers in the harbor of New York. No finer or harder working class of men will be found in any of the trades than marine engineers, and we feel the greatest regret that they were led into or advised to assume such a position. Fortunately for them, at the last moment they agreed to adjust their differences through arbitration, for, according to the rules of the United States Steamboat Inspection Service, by refusing to work or in any way preventing others from filling their positions the engineers are liable to lose their licenses; in fact, it is reported that several engineers at St. Louis lost their licenses recently for this very reason.

This is but one of the numerous phases of the present strikes. The country, outside of shipbuilding, is enjoying a wave of prosperity through the industry of our citizens, the great crops, and the demand for American products abroad as well as at home. The high prices of labor and material have not permitted shipyards to participate in this prosperity to so great an extent, and the numerous strikes of the boiler makers, blacksmiths, etc., along the coast, and especially in and about New York, have made the outlook in shipbuilding rather dubious. It will be well for labor agitators to consider the meaning of the reorganization of several of our shipbuilding companies before deciding to bring about more strikes. Here will be found evidences of the small percentage of profits, if not losses, in some of our large shipyards during the past three years.

Throughout the country manufacturers and employers of labor are now organizing to resist by concerted action the demands of the unions, stating that if this is not done it will be necessary to shut down. In contrast to the assertion that skilled labor is underpaid in this country will be found the statement of the members of the Mosley Industrial Commission which recently visited this country to investigate and report to their labor organizations in England the condition of the

American laborer and methods of manufacture. The twenty-three members practically are unanimous in stating that the American laborer is better educated, better fed, better clothed, and better paid than his English cousin. Unless there is a check in the labor agitation our present prosperity will vanish as a myth and the unions will discover that they have killed the goose that lays the golden egg.

WE have, from time to time, called attention in these columns to the urgent necessity of shipbuilders devoting their attention to improving and inventing life-saving appliances that will lessen the danger to the lives of passengers and crew. In reviewing the few attempts which have been made along these lines, we find devices fitted on some of the big ships now turned out from the yards at home and abroad which may be considered quite distinct innovations, and which lessen the dangers of the sea. Keen interest was shown in marine circles in many countries in 1900, when the heirs of Anthony Pollock offered $20,000 to the person who should present a device which, to a competent jury, should be deemed to effectively reduce the liability of accidents to ships at sea. The jury was selected from among the officials of the Paris Exposition, which was held that year, and many hundred designs and models were presented in competition. None, however, were considered worthy of the prize. A second competition was requested, when certain restrictions were laid down as to the kinds of appliances. An award of $2,000 was made to one competitor, but again none of the contrivances were deemed suitable for the entire reward. One of the jury recently stated that he believed it best to refrain from offering a single prize of large value, but rather to establish a fund from which periodical distributions of prizes and medals should be made, and thus the interest in this subject kept alive from year to year.

In our opinion the greatest advance in the protection of lives at sea has been made along lines which the late Anthony Pollock little dreamed of—we refer to wireless telegraphy. Many of the Atlantic liners are now equipped with instruments for transmitting and receiving wireless messages, and with the completion of the stations at Poldou, England, and Newfoundland and Cape Cod on this side of the Atlantic, messages are transmitted to vessels throughout the voyage; thus at all times the ships are in communication with the land, and also, if necessary, with each other. One company has undertaken to publish a daily newspaper on board its ships at sea from wireless dispatches received each day. With this system adopted and in working order the long delays which sometimes befall the Atlantic liners may be prevented, or, at least, their causes known to those on shore, and, if necessary, assistance sent to them at once. We believe the seas are preeminently the province of wireless telegraphy, and if by its adoption a single ship may be kept from foundering or a single life saved, the expense entailed will be more than compensated for.

THE bill providing for the appointment of a commission to revise the United States Rules and Regulations relating to steam-boiler design installation and inspection, failed to become a law through the legislative deadlock which prevailed in Congress during the latter part of the session. It is now generally believed that legislative action is not needed for the appointment of such a commission by the Secretary of the Treasury. Thus, the committee of the American Boiler Manufacturers' Association have taken up the matter with the Secretary and urged the prompt appointment of the commission, in order that it may proceed with the programme previously outlined. Here again, however, there is possibility of some delay, due to the fact that the Steamboat Inspection Service, with various other bureaus of the Treasury Department, is, on July 1 next, to be transferred to the new Department of Commerce.

If the commission can be appointed without special action by Congress, it will be most unfortunate if such appointment should be delayed on account of the future transfer of the inspection service to another department of the government. The need for the revision is too great for postponements which are unnecessary. Too long already have our rules and regulations been utterly unworthy in every way the maritime interests involved, the status and achievements of American engineers, and the prestige of the United States in the engineering world. The programme outlined in the bill, and which was noted in our comments last month, seems in every way admirable, and if we may assume to voice the desires of both builders and users of marine boilers throughout the entire United States, we would call most earnestly for the carrying out of such a programme of study and revision with the least possible delay.

Propellers for Launches.

Editor Marine Engineering:

I was much interested in the article on "Powering and Propulsion of Small Boats" in the March number, but it seems to me that the author uses too much pitch on all the wheels in the formula. I don't claim to be a propeller expert, but I have had some experience with both solid and reversible wheels, and I noticed that the engines that have the lower pitch wheels always seem to develop more power than the ones with higher pitch wheels of the same rated H. P., and, especially with reversing wheels, when I take the pitch off the boat makes better time and don't usually settle so bad aft. Of course some of the speed is due to the increased revolutions of the engine, thereby giving more power, but don't think it is all from the engine.

I think the pitch and diameter ought to be about equal, especially on the higher speed engines they are making now. (I mean in the ordinary pleasure and business launches. The racing machines are different.) There is an engine that is sold here a good deal that is supposed to make 600-650 R. P. M., and the 14 H. P. has a 20-inch wheel, 3 blades, 34-inch pitch. From the way I understand the theory of propellers, the more R. P. M. the less pitch they should have to get the best results. Take the electric launches made by the Electric Launch Company; their 5 H. P. motor has a 15 1-2 inch, 2-bladed wheel, 15-inch pitch, in a 30-foot boat, and they turn up 600 to 800 R. P. M., and the boats beat nearly all the gas-engine boats of the same size that have 6 and 8 H. P. engines.

Please give me your opinion on the above and oblige a subscriber. E. R. Koile.

Editor Marine Engineering:

In reply to your correspondent I would say that the formula and methods referred to place no restriction whatever on the relation between pitch and diameter, and are quite as applicable for low pitch ratio as for high. In Table 3 the pitch ratio runs from 1 to 1.8 and this is intended to cover the usual range of this relation. The value to be used in any particular case must be determined by the special circumstances of the case. In the illustrative examples it was intended to keep the revolutions down to about four hundred, or somewhat less, in accordance with the practice of many of our best makers of marine motors. This led to the particular pitch ratios selected. If revolutions of five hundred and six hundred are available the pitch ratio will be correspondingly less. Your correspondent is, however, in error in assuming that there is anything inherently better about the low pitch ratio rather than the high. Extended experimental research has shown that where the propellers are properly designed the one may be equally as efficient as the other. The chief difference between the two, in point of result, is that the low pitch ratio, other things being equal, will efficiently absorb a given power on a smaller diameter than the high pitch ratio. This is clearly shown by the values given in Table 3 and may be the explanation of the fact noted by Mr. Koile, that low pitch ratio wheels seem to develop more power than high pitch ratio. If each one is properly designed, however, with reference to the conditions of its operation, the return in useful work or the efficiency will be substantially the same, independent of the pitch ratio employed.

Regarding the electric launches, the result stated might be explained in a variety of ways. It is quite possible that they may have developed for moderate distances very much more than the normal rate of power. The figures 5 H. P. for the electric launch and 6 or 8 H. P. for the gas-engine launch have no meaning without more accurate information as to the power actually developed. Or, again, it may be that the propeller for the electric launch is better adapted to its conditions than that on the gas-engine launch. This might arise from a limitation in draft resulting in a limitation of diameter. This would call for a low pitch ratio and high revolutions, a set of conditions more readily filled by the electric launch than by the other.

Thus, if a diameter of 15 or 16 inches is all that can be permitted, this will presumably call for low pitch ratio and high revolutions; and if the revolutions are too high for the motor, then the wheel thus operated must work at a disadvantage. If, for example, 800 revolutions are required for the best efficiency, while the gas engine can only be driven at 600, then it is obvious that the electric motor can better meet the conditions than the gas engine. The credit, however, is not due to the low pitch ratio in itself, but to the fact that it may in special cases be better able to meet the conditions imposed. On the other hand, conditions often arise in which wheels of high pitch ratio must be employed. Such conditions are always found in small boats driven at high speeds, either by steam or gas engines. Thus, on all torpedo boats, fast launches, etc., pitch ratios of 1.5 and higher are commonly found.

The purpose in all propeller design should be to select such conditions or features as will seem to promise the best results, having in view the special circumstances of the case in hand. In the solution of such problems experience of course enters very largely, and the article referred to by Mr. Koile was written for the purpose of aiding in the application of such experience, and without any attempt to lay down hard-and-fast lines in reference to the adoption of any special feature. Low pitch ratios are best suited to fulfill some conditions, high pitch ratios others; and the selection between the two, or through the intervening middle ground, must necessarily depend upon the special conditions of the problem in hand. W. F. Durand.

The Future Traffic of Western Rivers.

Editor Marine Engineering:

Your recent articles concerning Western rivers I have read with interest, as for many years I have been identified with shipping on the Ohio. It is a deplorable thing to see these splendid navigable waterways almost denuded of shipping, save for the coal transportation, which will probably remain and grow, but there is little hope for anything different. The railways are direct and their freight-car switches go right into the factories and warehouses. The boats are remote and the rivers roundabout.

As to the passenger business, people want to travel

rapidly and from convenient stations, instead of leisurely from wharfboats located at the edge of muddy and steep landing places. There are certain trades, as between Cincinnati and Louisville and Pittsburgh, where excellent boats will, for many years, find profitable passenger and freight traffic. The steamers engaged in these services are kept up to date and they secure many excursionists. It really seems that if the sight-seeing, pleasure travel from these three great cities and the half dozen smaller cities along the Ohio was properly worked by means of improved steamers, it would start a new era in that particular line. Fast and luxurious steel-built day steamers, with good provision against fire danger, thoroughly advertised, and landing at convenient, clean-kept wharves, might draw a vast business during May, June, July, August, September, and October. The fire danger upon the present style of boats is a great handicap, although the actual losses are less than railways, but it is hard to convince people of that latter fact.

It may be that in the future some liberal investment of capital in a new type of steamer, embodying better ideas and more economical machinery, may work a revolution along the Ohio and Mississippi, but I doubt it.

"READER."

Lining Up Marine Shaft.

From *Power* for April we make the following extract of a correspondent's description of lining up new shafting on board ship:

A 1-16-inch hole is drilled through forward engine-room bulkhead, hole in stern post bridged, and a 1-16-inch hole drilled through bridge, both drilled holes to correspond with shaft center. A light is then placed forward of engine-room bulkhead hole and it can easily be seen through these two 1-16-inch holes. After-tank bulkhead hole is then bridged, a 1-16-inch hole drilled through bridge, and bridge adjusted so the light can be seen through these three 1-16-inch holes. Circles can now be described around these holes in the stern post and after-tank bulkhead with the 1-16-inch holes for centers, bridges removed, and boring bar set by circles. Of course any number of intermediates may be erected before bridges are taken out to get height of seatings, chucks, etc. This way all errors of a sagging line are avoided.

To line from tail-shaft coupling, shaft-alley bearings, of which there is often only one for each section of shafting, are not used. Each length of shafting is blocked on two blocks in such a way that the overhanging ends balance the portion between blocks, otherwise the shaft will sag, throwing couplings out. Faces of couplings are left a little apart for lining up, so a very keen taper wedge can be used between them. If now the after coupling of after line-shaft section is central with forward coupling of tail shaft and the taper wedge enters the same distance all around between their faces, tail shaft and after section of line shaft are surely in line; the next length forward may be proceeded with. When all the shafting is in, engine bed with crank shaft in place is set in the same way and forward crank shaft center will correspond with the 1-16-inch hole drilled in forward engine-room bulkhead. Before blocks are removed from under line shaft, shaft-alley bearings are put in place.

X.

Pich Process for Brazing Cast Iron.

A paper was presented at the monthly meeting of the American Society of Mechanical Engineers, April 7, on the features of the Pich process for brazing cast iron, by Mr. Wilfred Lewis.

The general scheme of the process is, first, the use of a coating over the surface to be joined. This coating is a metallic oxide (usually the oxide of copper), made into the constituency of varnish by some suitable liquid and applied on the surface with a brush. The effect of the metallic oxide is to act as a reducer of the carbon on the surface of the cast iron to be brazed, so that it passes somewhat toward a condition of carbon steel. Without this treatment, a sort of greasy condition of surface prevents adhesion. This reduction seems to penetrate for some distance (even three or four inches) into the actual texture of the cast iron, the graphite disappearing under the action of the heat applied by a gas and air torch. The ordinary brass filings usual in any brazing process are then laid upon the fracture, and melt into the joint at about 1,800 degrees Fahrenheit, making a union which is as strong, or stronger, than the original texture of the cast iron. As presented before the society, the pieces broken were an inch wide by one-half inch thick, and the brazing was effected in a small muffler made of firebrick. The brazed pieces when broken parted in another section from that where the first break appeared. The process took about twenty minutes for the small pieces used in illustration.

It was explained that the process could be applied to mend the break in broken teeth of gears, in pulley or wheel castings, and in massive work, even up to the size of the casting of a good-sized shears or punch. The cost of the material, exclusive of the labor necessary to apply the process, was about one-half cent per square inch. Its application was explained further for the making of one massive casting out of parts which it was convenient to cast separately, and also one of the newest developments, which was to fill blowholes in massive castings. The surface of the cavity was coated with metallic oxide, which is known as the "ferrofix," and, after being brought up to the brazing temperature, melted cast iron from the ladle was poured into the cavity. It united either with or without the use of the spelter, and when broken the metal was stronger where the blowhole had been, and the union so perfect that even with a strong glass no trace of the brass film could be detected in cases where brass spelter had been used.

Quantitative tests on duplicate samples seemed to indicate that after the reduction and brazing process the strength of the casting was greater by 5 or 10 per cent. in many cases than it was in its natural state.

No claim was made for increased strength at the joint where the tensile strength of the original material was higher than the strength of the fused brass; but in cast iron, where the brass used was stronger than the casting originally, this effect could be produced every time with a joint properly brazed. The applicability of the system to brackets or inconvenient projections on castings was also referred to. There seems to be no limit as to size of the castings to which it can be applied. The time required varies with size and the number of torches to be used—from five minutes to two hours.

Comparative Performance of H. M. S. Good Hope and U. S. S. Columbia.

In the April number of MARINE ENGINEERING was given an account of the trip of the H. M. S. *Good Hope* from Portsmouth, England, to Zanzibar, Africa, and from the *Journal* of the American Society of Naval Engineers is taken the following comparison of this trip of the *Good Hope* and that of the U. S. S. *Columbia* during her speed trial across the Atlantic in 1895. This comparison is of special interest, as it shows the actual number of men necessary to operate the engines of a modern cruiser when steaming at higher than cruising speed, and also as to the relative efficiency of Belleville and Scotch boilers.

The *Good Hope* was subjected to a test severer than most warships have to undergo, and it will be recalled that she is of the armored-cruiser type, of 14,000 tons displacement. A careful examination of her performance will indicate what sustained speed may be expected of warships when in service.

"The comparative results would indicate that the performance of the U. S. S. *Columbia* has not been surpassed by H. M. S. *Good Hope,* although the latter vessel is one of the latest examples of naval construction—in fact, a warship lately commissioned, and one launched seven years after the American cruiser with which she is compared.

"The trip of the *Good Hope* was probably intended by the Admiralty to prove a record performance. It was certainly so regarded by the naval world. To carry the Hon. Joseph Chamberlain as a Special Commissioner, the *Good Hope* was presumably selected by reason of the fact that she is a representative of the speediest class of large ships of the British navy. It was rather a good omen that she bore the name she did.

"As it was expected that the ship would make a record-breaking journey, her performance was closely watched by naval architects, marine engineers, shipbuilders, and naval officers. It was also well understood that her installation of Belleville boilers was on trial. In view of the important mission upon which the ship was sent, it can also be presumed that a trained and experienced force was detailed for the stokehole, so that the boilers received the best possible care and attention. The number of men detailed for duty in the fire rooms showed that at least an adequate complement had been provided.

"There was also a good-sized quota of men in all the higher ratings, so that particular attention might be given to the operation of all the auxiliaries in both engine and fire rooms. This complement, however, was not nearly as large as that deemed necessary by the builders of the vessel when conducting the official tests demanded by the government's contract.

"The voyage of the *Good Hope* was via the Mediterranean, Suez Canal, and then down the African coast to Durban. As the problem given the ship's complement was to steam the vessel at a regular speed of 17 knots, the route through the canal, although somewhat longer than that around the cape, favored the ship, since it permitted several stops to be made, and probably insured for the ship easier weather. While stopping at Suez and Zanzibar there were opportunities to make minor repairs and to secure fresh water. In other ways the journey through the Suez Canal assisted in diminishing the labor and strain of the engineers' force.

"The start was made from Portsmouth, England, November 25, 1902, 27 of the 43 Belleville boilers being used to secure the required power necessary for making the prescribed speed. Heavy weather was only experienced in the Bay of Biscay, and then it was necessary to slow down for only a few hours. Afterward the regular routine was carried on, and this routine has been described in the text of the article. It will be noted that occasional trouble occurred in the engine room.

"Reverting to the voyage of the U. S. S. *Columbia* from Southampton to New York, that vessel steamed out of the English port with fires in all her furnaces, the boiler installation consisting of 8 double-end Scotch boilers, 4 furnaces being at each end. At no time were fires hauled in any furnace. The vessel ran at full speed during the entire voyage, except for four hours when the ship was slowed down on account of fog.

"The *Columbia* was ordered to proceed to New York, using all boilers under natural draft, and to use all three sets of engines. For the first two days the limit of coal consumption was not allowed to exceed 200 tons per day. During the remaining four days the limit was not allowed to exceed 225 tons per day. The average coal consumption during the trip was about 212 tons per day.

"It is exceedingly regrettable that the *Columbia* was not run under forced draft for a day or two after leaving Southampton. It would then have been possible, by reason of the arrangement of the ship's bunkers, to have supplied the furnaces with all the coal that could have been burned. When it was suggested, near the end of the run, to use forced draft, it was found that it would not be possible under such conditions, due to the fact that all the bunkers in proximity to the fire rooms had been emptied, and therefore sufficient coal could not be fed to the boilers when the consumption was greatly increased. The experience of the *Columbia* in this respect conclusively shows that the question of rapidly getting coal out of the bunkers is one of military importance, and that more attention should be given to the subject.

GENERAL FEATURES OF BOTH SHIPS.

	H. M. S. Good Hope.	U. S. S. Columbia.
Displacement, tons	14,100	7,350
Length	500	411.5
Breadth (load line)	71	58.3
Draft, mean	26.5	22.4

TRIAL FIGURES.

Knots speed	23.05	22.8
R. P. M.	122.4	151.72
I. H. P.	31,088	18,509.2
Pressure	....	145
Boilers	43 Belleville	8 Scotch
Boilers in use	27	all

"The following deductions can be made:

"1. *Columbia's* average speed per day exceeds that of *Good Hope's* maximum.

"2. *Columbia's* daily run exceeds *Good Hope's.*

"3. *Columbia's* maximum speed per hour exceeds *Good Hope's.*

"4. *Columbia's* average speed per hour is greater than *Good Hope's.*

"5. *Columbia's* average horse power is greater than *Good Hope's.*

"6. *Columbia's* consumption of coal per horse power is less than *Good Hope's.*

"7. *Columbia's* coal consumption per 1,000 tons of displacement at 10 knots is less than that of *Good Hope.*

"In making comparison between the *Good Hope* and the *Columbia,* the respective displacement of the two ships should be considered. The facts should also be remembered, however, that the *Columbia* had a much smaller complement of men in her fire rooms than did the *Good Hope* in developing practically the same horse power. As all fires were lighted in the furnaces of the *Columbia,* the fire-room conditions of that vessel ought to have been much more severe.

"The following comparative statement as to the performance of H. M. S. *Good Hope* and U. S. S. *Columbia* will be of interest to all the readers of the *Journal* in noting in some respects the progress that has been made in naval engineering design during the past five years.

"The records of the two vessels are also shown in tabular form:

.....	H. M. S. Good Hope, Nov 25-Dec 26, 1902.				U. S. S. Columbia, July 26-Aug. 2, 1895.	
	Best day run.	Portsmouth to Port Said.	Suez to Zanzibar.	Zanzibar to Durban.	Best day's run.	Southampton to New York.
Total knots run	....	2,905	2,840	1.590	....	3,090
Day's run, knots	440	376	401	356.5	462	442
Speed, average knots per hour	18.8	15 7	16 7	14 85	19.25	18.41
Days, straightaway	....	7.73	7.1	4.46	....	6.98
I. H. P., main engines	10,639	10,175	8,571	6,600	10 554	9 576
" aux. machinery	....	....	....	....	....	140
Tons of coal per day, all purposes	282	221	254	178	230	212
Tons of coal per day for auxiliaries	....	....	....	....	....	11.33
Pounds of coal per I. H. P. per hour, main engines	2.3	2.31	2.59	2.34	1.93	1.95
Pounds of coal per I. H. P. per hour for all purposes	2.48	2.55	2.69	2.74	2.03	2.07
Distance run per ton of coal, knots	1.56	1.70	1.58	2	2	2.08
Pounds of coal consumed per knot run	1,435	1 316	1.419	1,119	1,115	1,074
Pounds of coal used per ton of displacement	2.38	2.24	2.42	1.90	3 6	3.5
Estimated relative coal consumption per 1,000 tons displacement at 10 knots	$D_3^2 S^3$		9.49	.....		8.98

TABLE OF PERFORMANCES OF H. M. S. GOOD HOPE AND U. S. S. COLUMBIA.

"To accomplish the satisfactory results noted for the United States ship, it may prove interesting to compare the working personnel of the engineer's force:

H. M. S.	U. S. S.
1 fleet engineer,	1 chief engineer,
2 engineers,	1 passed assistant engineer,
4 assistant engineers.	2 assistant engineers,
2 artificer engineers,	2 naval cadets as engineers,
3 chief engine-room artificers,	12 machinists, chief and 1st class,
20 engine-room artificers,	3 boilermakers,
10 chief stokers,	1 blacksmith,
23 leading stokers. 1st class,	8 water tenders,
10 leading stokers, 2d class,	15 oilers,
211 stokers, 8 stokers, 2d class,	67 firemen, 1st and 2d class,
6 engine-room artificers for instruction,	78 coal passers,
83 seamen, used as coal passers, stokers, tube sweepers, etc.,	12 seamen detailed from deck,
375 total engine-room complement H. M. S.	202 total engine-room complement U. S. S.

"The above comparison ought to give some pretty conclusive evidence as to whether or not there is an overcrowding of men in the fire and engine rooms of the United States warships. It will be observed that the horse powers developed on the two ships were nearly the same, and yet 83 men from the deck were detailed for duty in the stokeholes of the *Good Hope,* while only 12 of the deck force were called upon for fire-room work during the run of the *Columbia."*

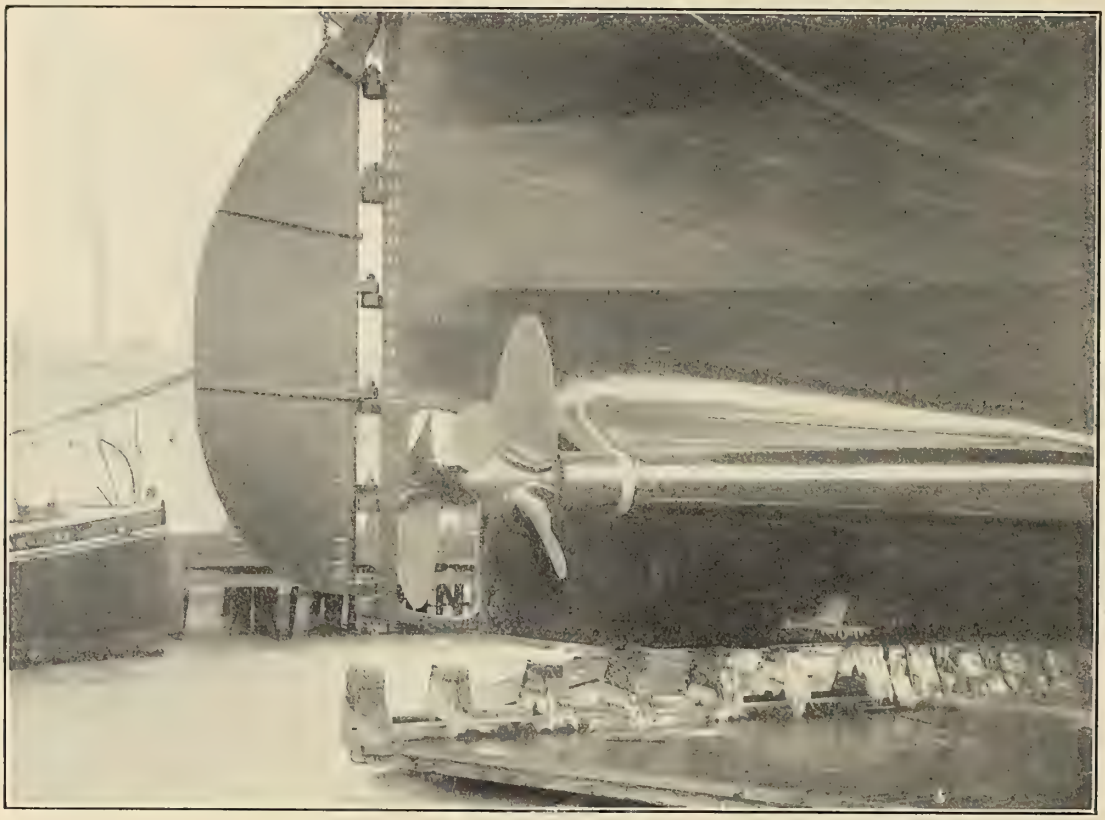
PERSONALS.

Irving M. Scott, of the Union Iron Works, died of heart trouble in San Francisco, on Tuesday, April 28. This is a heavy blow to the shipbuilding interests of the country, as Mr. Scott stood in the first rank of that industry. While with the Union Iron Works Mr. Scott had under his supervision the building of the war vessels *Oregon, San Francisco, Monterey, Ohio, Olympia, Charleston, Wilmington,* and *Marietta.* Mr. Scott was born at Hebron Mills, Baltimore County, Md., in 1837, and began his business career as a draftsman.

J. W. Hendry, formerly hull draftsman with the Bath Iron Works, is now with the New York Shipbuilding Company as hull draftsman.

Charles R. Sessions, who was formerly ship draftsman at the Union Iron Works, San Francisco, Cal., has taken a position as ship draftsman with the New York Shipbuilding Company.

David Bell, the veteran shipbuilder of Buffalo, died on Monday, April 20, in his eighty-sixth year. Mr. Bell was of Scotch birth and had lived for over sixty years in Buffalo and was one of the pioneers in the iron business. At his works he also in the early days built locomotives which were the largest of their time. Most of his work was in iron shipbuilding and among the vessels turned out are many of the old revenue cutters. Mr. Bell was always a very public-spirited man and took the greatest interest in the young men.

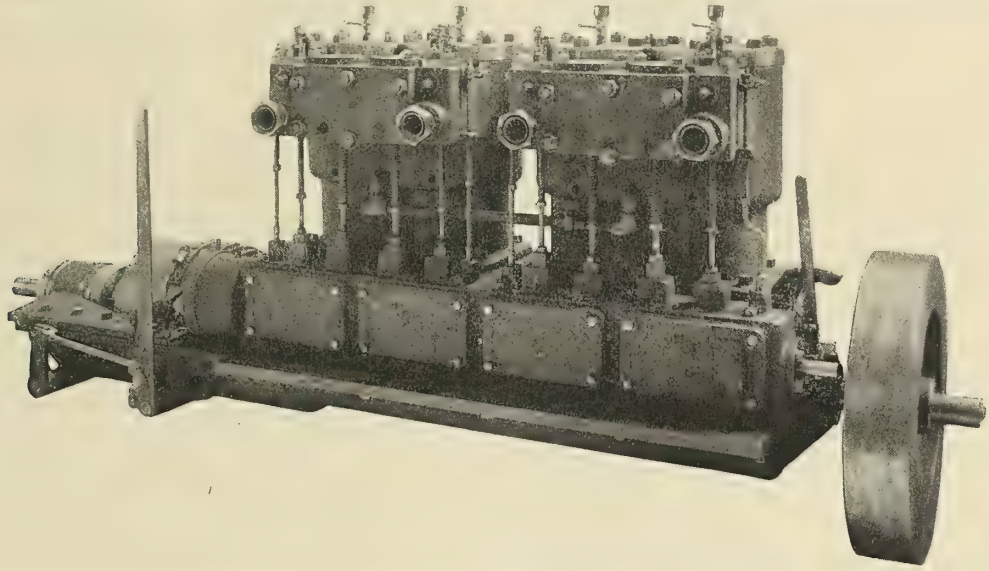


BOW AND STERN VIEWS OF THE NEW FREIGHT STEAMSHIP MASSACHUSETTS, IN DRY-DOCK AT MORSE IRON WORKS, BROOKLYN, N. Y. THIS SHIP WAS RECENTLY COMPLETED BY THE NEW YORK SHIPBUILDING COMPANY FOR THE ATLANTIC TRANSPORT LINE.

ENGINEERING SPECIALTIES.

Four-Cycle, Four-Cylinder Marine Engine.

The 25 horse-power four-cycle, four-cylinder marine engine herewith illustrated, made by the Frank M. Watkins Manufacturing Company, Cincinnati, Ohio, embodies the latest improved ideas in this type of motor on the market to-day. The material, workmanship, and construction are all of the very highest grade, all bearings are bushed with heavy phosphor bronze, while the cams, etc., are case-hardened, insuring long life of the engine. The crank shaft is made extra heavy and of the very best grade of open-hearth steel, while the connecting rod is made of heavy phosphor bronze. All parts of the engine needing attention are accessible.



MARINE GASOLINE ENGINE OF THE MULTIPLE-CYLINDER, FOUR-CYCLE TYPE.

The igniting apparatus is of the hammer-break type. One of the most important parts on a gas engine is the igniter plate, and here it is that most of the trouble is apt to occur on account of the plate being poorly constructed, poorly insulated, and inconvenient to clean. The igniter plate used on this engine is made to overcome these points; the insulated pin is covered with mica washers 2 1-2 inches long, thus making it impossible for the electric current to pass over the insulation. The igniter point can be easily cleaned in an instant by turning a small thumb nut while the engine is running.

The cylinder heads and valves are all well water-jacketed, and the water pump is made of brass, being what is known as the plunger type, and placed in such a position on the engine that it is easily accessible. The pump is fitted with a special attachment to prevent hammering and jarring of the pipes, which is very annoying and damaging to an engine.

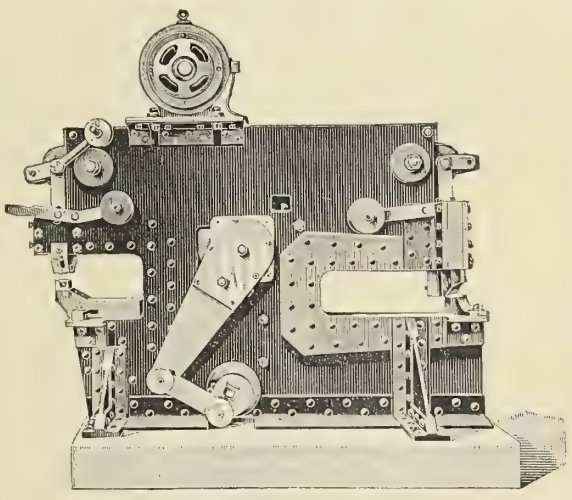
The inboard reverse gear used on these engines is of the enclosed type, with sprocket gears, which are considered better than bevel gears. All gears are of bronze and steel, running on hardened steel spindles. The engines are fitted with roller thrust bearings to catch the thrust for both forward and backing motion. The lubrication used is of the latest improved system.

Further particulars regarding this engine can be obtained by writing the manufacturers.

Patent Punching and Shearing Machine.

The Johns patent punching and shearing machines are made of wrought iron and steel, which means that they are lighter and much stronger than machines of cast iron; they are also fitted with most economical driving mechanism, thus gaining great saving in the driving power required. The machine may be driven by a small motor placed conveniently on top or at the side. The main shaft runs in a gun-metal bush with ring lubrication, and drives a crank through which power is transmitted to the punch and shears. A flywheel is mounted on the main shaft. By means of the connecting levers the greatest pressure is exerted at least expense of power.

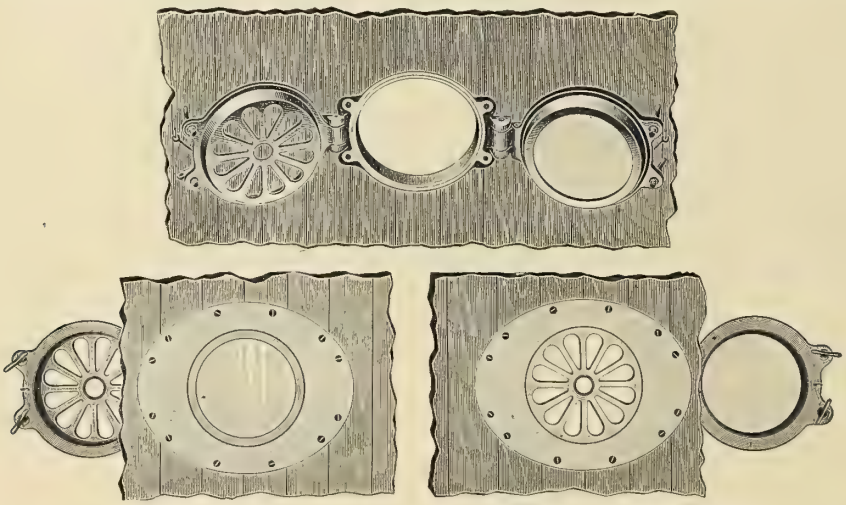
The machines occupy small floor space and may be handled by unskilled workmen. Also, on account of the material of which they are made, they may be left outdoors without protection from the weather. The machine here illustrated is a combined shears and punch.



PUNCHING AND SHEARING MACHINE.

In large shops, where most of the punching and shearing work is done at the same time, a single plate shear and an extra bar cutter are to be preferred, so that plates to be cut do not interfere with the punching. The type here shown has an overhanging jaw for punching flanges of beams and channels as well as webs, plates, etc. The die block consists of forged steel and does not have to be changed for the different kinds of work. The jaws may be made of any depth. The shears are fitted with adjustable knives set at an angle of 60 degrees. Both tools have a quick-return motion, and the plunger makes a pause at the highest position, thus giving time to shift the material and to make use of every stroke.

These machines are built in a variety of styles to perform different classes of work, and further particulars may be obtained by writing to the makers, Henry Pels and Company, Morris Building, New York, N. Y.



COMBINED DECK LIGHT AND GRATING. VIEWS TAKEN FROM BELOW AND ABOVE.

Combination Deck Light and Grating.

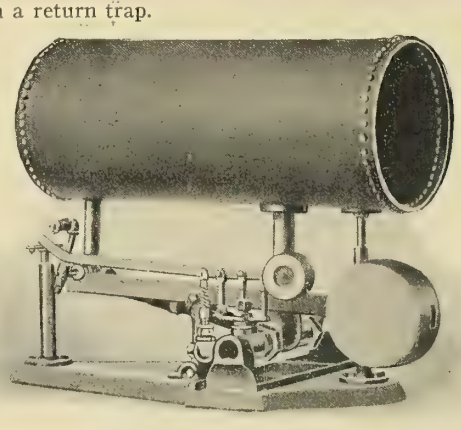
The accompanying views illustrate the form of combined deck light and grating which is made by the Edson Manufacturing Company, 255 Atlantic avenue, Boston, Mass.

The device is simple in construction and especially adapted for requirements on board yachts. It consists of an oval plate 14 by 11 inches, in which is set an 8-inch ring for receiving from below either a deck light or a grating. The frame holding the light is fitted with a ring carrying a rubber packing. This is hinged on the lower side of the plate and is held by a screw-hinged joint and two thumb screws used for clamping the frame upon the rubber packing to make a water-tight joint. These lights are made with clouded or clear glass, as desired, about 5-8 of an inch thick and amply strong to meet any required strain. The diameter of the exposed glass is 7 inches. When it is desired to replace the light with the grating the two thumb screws are loosened and the plate drops down, swinging back upon its hinge, and may be hooked back out of the way. The grating, which is also attached to this frame on the opposite end, works upon a hinge joint with screw, the same as the light. This grating is not provided with packing, as it is not necessary. It carries two thumb nuts or screws, the same as the light, so arranged in the frames that it is impossible for them to become detached or unscrewed from their place. Both the grating and light, when screwed into their proper position, are flush with the plate and with the deck.

This light is made of wrought brass, nicely finished, and should appeal to yachtsmen as a long-felt need for a combination deck light with grating all in one plate.

The Morehead Return Trap.

The condensation from any steam-heating apparatus must be removed, and the more quickly it is done the drier and more effective will be the heating surfaces. It is the greatest extravagance to waste this condensation, as it is pure water and hot. The most effective way to utilize the heat it contains is to deliver it directly into the boiler, and in no other manner can the condensation be handled as quickly and with the same economy as with a return trap.



PATENT RETURN TRAP.

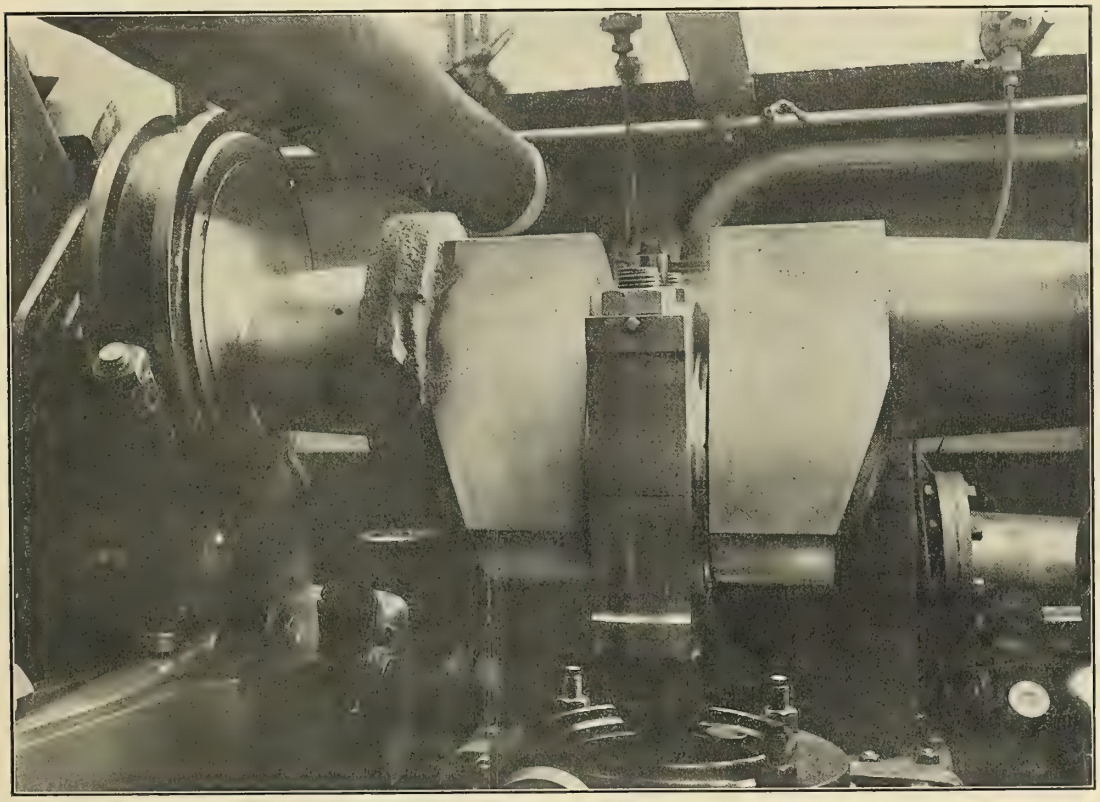
The Morehead return trap is constructed of steel, the heads and longitudinal seams being closely riveted and calked to withstand any pressure carried on the boiler without breaking, which is impossible with cast-iron traps. It is the embodiment of simplicity, there being no rubber joints to blow out or leak, and only one valve,

which is on the outside. All working parts are on the outside, in plain sight, and easily accessible. There is no ball or globe float inside the receiver to collapse, leak, rust, or stick.

This trap is located six feet or more above the water line of boiler. The water from the condensing surfaces is forced by the pressure of steam from behind through a pipe leading to the trap, with a swing check valve close to the latter. As soon as sufficient water has entered the receiver to overcome the counterbalance the receiver tilts down, allowing the water to pass through the discharge pipe, at the same time opening the steam valve, which has a pipe connected with the dome of the boiler.

By equalizing the pressure on the surface of the water in the receiver with that in the boiler, the water, in simple obedience to the laws of gravity, flows into the boiler. As soon as the receiver is empty it tilts back as before, and again refills. When once set up it requires no further attention. It takes the water from the condensing surfaces whether they are above or below the water level in the boiler, and automatically returns it to the boiler at the temperature due to the pressure at which the steam is condensed. There is no outlet by which the steam can be wasted. The trap is quick and positive in opening and closing and in delivering the water into the boiler against any pressure, regardless of fluctuations of pressure. It may also be used to supply all the water needed in the boiler from the feed-water pipe, providing there is enough pressure on the main to lift the water to the trap, thus performing the duties of a pump or injector. It operates equally well with high- or low-pressure coils, or coils using exhaust steam, allowing no condensation to collect in them.

Where a return trap is not employed the usual way of handling condensation is by means of a pump. A comparison of the two methods shows many points of advantage in favor of the former. A pump will not lift water at a temperature exceeding 212 degrees; a Morehead return trap will. A pump consumes an extravagant amount of steam to do a very little work, while a Morehead trap takes very little indeed. It is claimed that it requires practically no attention; needs no lubrication; will not race or run away; is noiseless; requires little room and no foundation. Full information may be obtained by addressing the American Blower Company, of Detroit, Mich., or any of its branch offices.



BROKEN SHAFT REPAIRED IN PLACE BY THE USE OF THERMIT IRON.

Making Repairs by Thermit Iron.

Two interesting repairs of a broken shaft and stern frame have taken place on the other side of the Atlantic by the use of Thermit iron. This material for welding was patented by the Allgemeine Thermit Gesellschaften, Essen-Ruhr, Germany, the American agent being Mr. C. B. Schultz, 149 Broadway, New York, N. Y.

This last January the Hamburg-American steamer *Sevilla,* of 900 tons, collided on the river Elba with another steamer and broke her stern post. The section at the place repaired is 19 5-8 inches by 7 7-8 inches. Heretofore the repairing of all such damage could only be effected by taking the stern post out and repairing it in the

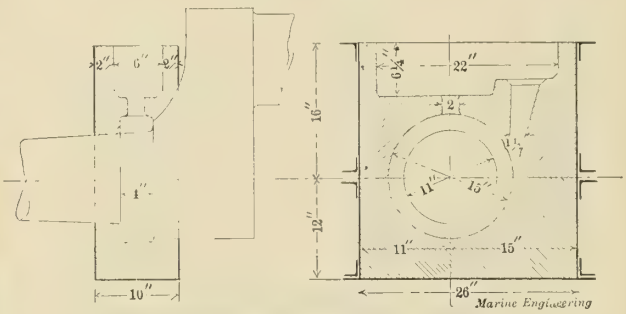
forge, and replacing it. This work would have laid the steamer up for about ten or twelve weeks, and at the cost of from $20,000 to $25,000 altogether.

A space of about 1 1-8 inches was chipped away at the break in order to give the welding iron a chance to run into the fracture, and there was cast around the break a strengthening ring of 2 inches thickness by 6 inches in width, and about 700 pounds of the iron were used in a so-called automatic crucible such as described in October, 1902, number of MARINE ENGINEERING. A mold, consisting of a divided box of sheet iron with a high refractory lining, was placed about the break. The welding was effected after the block had been heated to

BROKEN STERN FRAME WELDED IN PLACE.

a red heat and by allowing the mold to remain in place for four hours. As the amount of metal used in this case was large, the slag was allowed to flow over the rim of the mold into a dry sand bed. The iron in the runner, as well as in the racers, was in one piece with the weld, and it was impossible to break them off even with many blows from sledges and a heavy ram, and they finally had to be cut off with a chisel. As a further proof of the complete welding of the metal, two small holes were drilled through the weld, which showed satisfactory density. Afterward the weld and neighboring parts of the stern frame were annealed for about twenty hours in a hot charcoal fire. The cost of the repair amounted to less than $1,000, and the *Sevilla* has since completed a round trip to Buenos Ayres in good condition.

The second repair referred to was accomplished a few months ago on the paddle steamer belonging to Schurmann Schne, Ruhrort. The repair was made without removing the shaft, and as shown in the illustration. The diameter of the shaft is 13 3-4 inches, and it was broken more than half through. The crack was chiseled open, as in the stern-post repair, and 290 pounds of Thermit iron poured into the mold, a sketch of which



MOLDS USED FOR REPAIRING BROKEN SHAFT.

accompanies this article. The work took but twenty hours, and the steamer has been in regular service since the day after the welding was done. The shaft was *not* thrown out of line as a result of the welding.

Self-Adjusting Packing Ring.

A packing ring which may be used on any form of piston, either water or steam, is here illustrated. It is called the Roberts self-adjusting packing, and consists of six parts in the shape of rings, namely, one bull or jump ring, two steam rings, and one center ring, and two steam joints. The first three named rings are fitted into grooves turned in the bull or jump ring, the center ring being adjusted by a spring which is placed

SELF-ADJUSTING PACKING RINGS, SEPARATE AND ASSEMBLED.

behind it and therefore braces it against the bore of the cylinder. The purpose of this ring is to carry the weight of the piston and to steady the motion. The outer or steam rings are fitted in their respective grooves at each end of the bull ring and constitute the packing. They are readily expanded by the steam pressure to fit the cylinder. Thus, when the piston moves forward the steam fills the groove in the rear outer ring, expand-

ing it in all directions to the full diameter of the cylinder, and, when the piston returns, the forward outer ring is acted on in the same way by the steam behind it.

Thus it will be seen that but one ring is bearing on the cylinder wall at a time. No oiling is required.

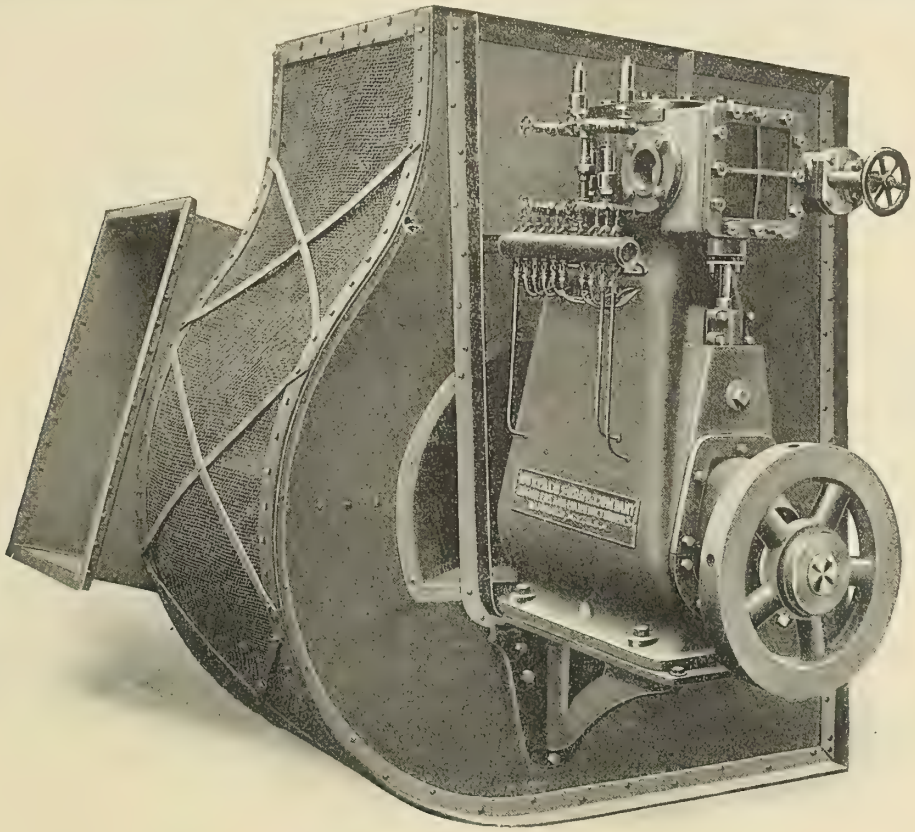
The two steam joints are inseparable parts of the packing, and are fitted in the rib of the bull ring to prevent the steam rings from turning and the steam from passing from one side of the cylinder to the other. The steam rings have a groove into which is dovetailed a tongue; thus these rings may wear down and yet do their work. The steam joints will also prevent rings from falling out in the cylinder.

It is claimed that by the use of this packing the friction of the piston is greatly reduced. Full particulars may be had by addressing the Roberts Steam Piston Packing Company, Bullitt Building, Philadelphia, Pa.

Combined Ventilating and Forced-Draft Fan.

A special and interesting feature in fan building is receiving attention by the Buffalo Forge Company, of Buffalo, N. Y. This is the fan used on board vessels for the double purpose of providing forced draft for the ship's boiler and ventilation for the different parts of the vessel. The conditions of the installation, which are common for similar work, necessitate strong, substantial construction, and the best grade of engine for high speed under continuous use.

Usually for serving these two purposes two distinct fans are necessary, one for furnishing draft for the boiler and the other for ventilation for the ship. The combination fans built for the United States revenue cutter No. 8 are a very good sample of this special type and have proven highly successful. They were two in number, approximately 70 inches high, having a wheel 50 inches in diameter and 22 inches wide at the center, the blades having an easy curve, and made of heavy steel plate securely attached to T-iron spiders, all accurately balanced in cast-iron hubs to secure quiet and easy running without vibration. The side casings were made of heavy steel plate, the ends being constructed of heavy wire screen instead of the usual steel casing. The fans were equipped with Buffalo Forge ring oil bearings with extended shaft for direct connection to a Buffalo 5 by 5-inch double, vertical, double-acting engine with cylinders above the shaft. The engine was of first-class construction and workmanship, being especially specified by Capt. Collins, engineer in chief R. C. S.



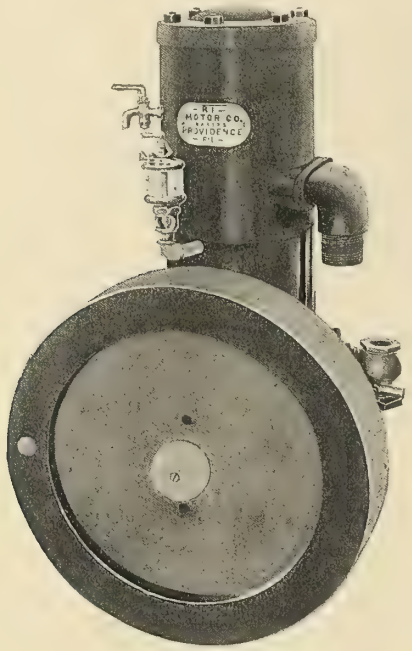
FAN USED FOR VENTILATION AND FORCED DRAFT ON SHIPBOARD.

After the construction of the fan and engine the system is very simple. The fan was supplied with a side connection, to which galvanized-iron ducts to different parts of the vessel were attached. Through these ducts the air from the ventilated portions is drawn and blown out through the screen ends, supplying the draft to the boilers.

By using this system the double service is accomplished with the single cost of fans, care, power, and space.

Two-Cycle Gasoline Motor.

Simplicity is the most prominent feature of the Rhode Island motor, as each part is so constructed as to require the least attention. The sparking device is very simple, being regulated by a plug, and the entire mechanism can be removed without taking off the head of the cylinder or breaking any joints or pipes. The electrodes are fitted with platinum bands. The vaporizer is guaranteed to work with the same degree of precision under any conditions of temperature and is of the Lunkenheimer type. The bushings, eccentric straps, and connecting rods are of polished phosphor bronze, thus giving long life, and all parts are made standard and



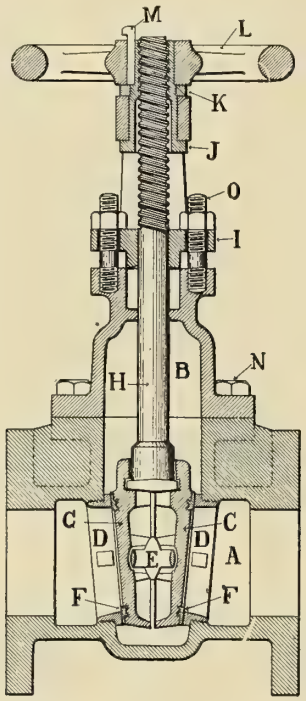
A TWO-CYCLE MARINE ENGINE.

interchangeable. For cleaning out the crank case or adjusting the connecting rod a handhole is placed at either side of the cylinder. A complete system of water-cooling, including the cylinder head and exhaust, is fitted, which will prevent the engine from overheating. The water is circulated by means of a direct-connected pump. A good muffler is fitted on the exhaust, which, while deadening the sound, does not reduce the power of the engine. The pump, eccentric straps, trimmings, and fittings are of phosphor bronze, and, if desired, the cylinder head can be supplied in nickel. The engine is easily started by oscillating the flywheel backward and forward four or five times and at the last turn giving it a swing from right to left, when a spark will occur and the engine be set in motion. As the engine takes but little room and requires but little oil, it is specially adapted for auxiliary work. The maker is the Rhode Island Motor Company, of Providence, R. I.

A New Valve.

A new and original type of gate valve has recently been put on the market which is called the Lenticular double-disk taper-seat gate valve, the word lenticular denoting a double convex form or lens shape, taking its name from the design and shape of the center piece between the two disks.

In this valve there are only four parts which move by the action of the screw: the two disks, the lenticular bearing on center piece, and the stem nut. The disks are provided with recesses or pockets to admit the shoulders or projections cast on the stem nut, and from which the disks are suspended. On the back of each disk is a projection with concave face to fit the convex faces of the center piece, thus making a true center bearing. The construction and relation of the rings on the disks and of the center piece are such that the disks have perfect freedom of movement around the center. The disks are also provided on either side with guide



DOUBLE-DISK TAPER-SEAT GATE VALVE.

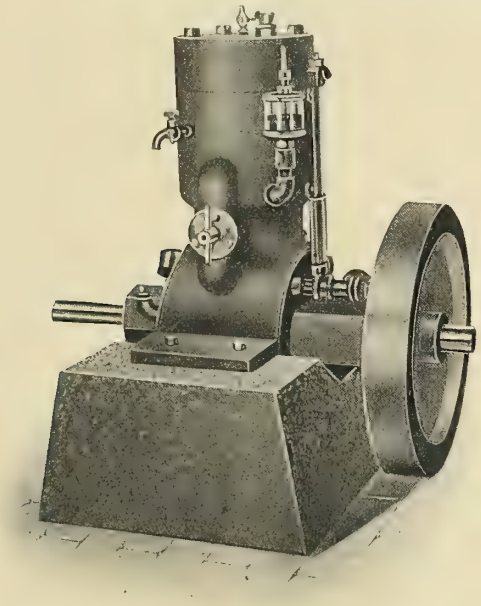
wings which work between the guides cast in the body of the valve, and their function is to control the position of the disks when opening or closing the valve. By means of these guides the disks are held in a central position, thus making it impossible for them to come in contact with the seat rings, except at the moment of closing the valve, thereby avoiding all liability to mar or deface them. The center piece has two convex faces, segments of a true sphere, and arranged in a ring form to allow the stem to pass through. The convex faces of the center piece and concave faces of the projection on back of the disk conform to each other, so that when the valve is closed the disks are forced to their seats from the center with an equal, evenly distributed pressure at every point.

This type of valve, which is peculiarly adapted to high-pressure steam service, is made by the Kennedy Valve Manufacturing Company, sales office 63 Beekman street, New York, N. Y., with works at Coxsackie, N. Y.

Two-Cycle Gasoline Launch Engine.

A Genesee engine, sold under a two years' guarantee, is herewith illustrated and described. The engine is of the two-cycle type, thus reducing the weight necessary for the same amount of power as compared with a four-cycle engine. The head cylinder and crank case are of separate castings, of close-grained gray iron, and the cylinder is bored and faced. The cylinder is so designed that the burnt gases will pass out through the exhaust before a fresh charge is admitted from the feed port. The connecting rod is of phosphor bronze, constructed so as to take up the wear, and the crank shaft is a well-balanced solid steel forging turned and fitted to long phosphor bronze bushings.

The contact spark with the hammer break is used for igniting the charge. The igniter rod is operated by an eccentric and cam; the downward motion of the rod



TWO-CYCLE GASOLINE ENGINE.

when the cam slips off the eccentric is quickened by a strong spring. A small projection on the rod strikes the movable electrode, thereby making a quick hammer break of the contact. The electrodes are held apart by this projection for the remainder of the stroke and until the rod is moving upward. The electrodes are in contact long enough to insure a good current, but not so long as to rapidly exhaust the batteries. The time of the spark may be adjusted. The current for ignition at starting is supplied by a dry battery of six cells. When under way, by means of a two-point switch the cells are thrown out and the sparking dynamo is thrown in.

Speed regulation is not obtained by throttling the amount of gases admitted to the crank chamber, but by throttling the amount of gases admitted to the firing chamber. This insures a constant mixture at all times. A Lunkenheimer vaporizer is used. Water circulation is supplied by a simple rotary pump; both cylinder and head are jacketed. The engine is made by the Genesee Launch and Power Company, Rochester, N. Y.

QUERIES AND ANSWERS.

Q. 150.—How do you ignite the oil in a fuel-oil burner before getting the proper pressure to eject the oil from the burner; and how do you start an oil burner when there is no burning substance on the fire grate?

A.—With the usual type of fuel-oil burners the pressure required to eject, and atomize or pulverize the oil, is not obtained from the heat developed by the burner, but is provided by an entirely independent source, such as a gravity or pressure feed for the oil combined with a jet or blast of air or steam for the pulverization. This exists quite independently of the fact whether the burner is lighted or not, and it is only necessary to turn on the oil and the blast in order to project the atomized spray from the burner into the furnace.

The easiest method of lighting a fuel-oil burner is to turn on the oil and blast in such proportions as experience may indicate sufficient to give a small atomized spray. A torch is then thrust into the jet, which usually ignites without difficulty.

The combustion of fuel oil is, however, quite imperfect until the temperature in the furnace has risen to a point sufficient to vaporize the oil as it enters and thus produce the necessary conditions for economic combustion. The jet is liable, therefore, at first, to burn irregularly and with a smoky flame, such conditions gradually improving as the temperature of the furnace becomes higher. In some cases where only a few burners are to be lighted, a little wood fire may be built directly in front of the jet and before the latter is turned on. When the fire is well under way the jet may be turned on as before, and the burning wood will serve to vaporize the oil and hold the conditions more steady until it becomes sufficiently hot to vaporize the oil as noted above. Instead of wood a piece of waste soaked in oil may be used, and in any event the torch employed should be one capable of burning for some little time and not readily blown out.

Different burners require different methods for their best operation, but a few trials along the lines indicated should serve to develop the best method in any particular case.

Q. 151.—Will you please give me your opinion of the practical value of a two years' course in naval architecture to a young man who has had four years' experience in yard and drafting room and who intends to make ship construction his life work? Also, what university, in this country or abroad, is in your opinion best adapted for a course of that kind? J. H. H. H.

A.—The value of such a course will naturally depend very much upon the preparation which the student has had, especially in mathematics and such other subjects as will fit him for taking the course with advantage. It should be understood that the purpose of a school or college giving instruction in engineering lines must be to pay first attention to those subjects in which instruction cannot be readily obtained in practical life, or in which suitable training could only be acquired at the expense of a disproportionate effort.

A young man who has had four years' experience in shipyard and drafting room will naturally have acquired a very considerable amount of information regarding ship construction. Much of this, however, will be superficial in character, and he will fail to properly understand the relations between many things which he

may have observed and the proper dependence of the various parts of the work one upon another. He will naturally have a very imperfect idea of the fundamental principles underlying the work of ship construction, and of the reasons why the work is carried out in one way rather than another. He will find it difficult to act independently, and, in all cases involving design or adaptation, must necessarily be governed chiefly by such examples as may come before him and which may seem to apply to the case in hand.

The chief benefits which such a man may hope to receive from a course of instruction are these:

He may hope to become acquainted with the "reason why," and thus acquire the foundation which, with the aid of suitable judgment, may make of him a designer in the true sense of the word.

He will also acquire a knowledge of the best methods of undertaking the study of the various problems which may present themselves in his daily work, and will thus become fitted to make the best use of such faculties as he may possess.

In order, however, that he may be able to attain these ends it is needful that he should possess some aptitude for mathematics and the mathematical method of studying problems, as well as a capacity for close, accurate, and logical reasoning, based upon such facts as may be presented by the problem in hand. In other words, in order to profit by a course of higher study, he must naturally possess aptitude for such work and for the practice of the higher branches of the profession.

As to whether such a young man can acquire the needed training in two years or not, will depend very much upon the extent of his previous preparation, chiefly in mathematics. Two years is none too long a time to give almost entirely to the study of the science of marine construction; and if a preceding year or more must be taken in work of a preliminary character, obviously the total time should be extended to three years or more. In order to fully profit by a regular course of study in naval architecture and shipbuilding, the student should have a good general education, and in mathematics should be familiar with the subject through calculus. He should also have at least a good elementary knowledge of mechanics, and preferably strength of materials. To the extent to which his preparation may fall below these requirements, to such extent will he require preparatory training, and to a corresponding extent will he fail to receive full benefit from the time devoted to professional subjects.

Having in view the scientific character of the development along all engineering lines during the past few years, it is clear that no one who intends to make ship construction a life work should deprive himself of such advantages as may come to him through a course of theoretical training, the best which his circumstances will allow him to obtain.

Special instruction is given in such branches at Cornell University, at the Massachusetts Institute of Technology, at the University of Michigan, and at the Webb School, Fordham Heights, New York. Correspondence with these institutions should enable the student to judge for himself as to which is most likely to furnish the instruction best suited to his particular needs.

Q. 152.—Will you kindly answer through the columns of your paper the following questions:

1. With a new vessel on the ways, how would you put in the stern tube and pipe?

2. State in detail and rotation what parts of engine and machinery you would place in the vessel.

3. With engine 50 inches diameter of cylinder by 5 feet stroke, steam 100 pounds, how would you find, without the use of an indicator, the mean effective pressure and the amount of water in cubic inches it would require to make this amount of steam (engine to cut off at half-stroke)? W. A. K.

A.—(1) and (2) Questions of this character can rarely be answered satisfactorily. They are questions of practice and vary widely in treatment, according to the particular ideas of the engineer in charge of the work. With regard to the stern tube, the question of putting it in we may suppose to refer to the method of lining up the boring bar and thus locating the tube. As for putting it in place, no practical man will have any especial difficulty once the ship is bored out and made ready.

Regarding the location of the boring bar the following principles should be borne in mind, and if clearly understood they may be fulfilled in the manner best adapted to the case in hand. In the first place the drawings will locate the center line of the shaft. In any event the after end of this line must be located practically at the center of the boss aperture left in the stern post. Measurement from the drawing will serve to locate likewise the center line at the after bulkhead or forward end of the tube. The problem then becomes one simply of setting up a boring bar in the line thus determined. This may usually be done most readily by locating the center line just at the points where the ends of the bar will come, marking them by cross wires or in any other convenient manner, and then adjusting the bar so that its centers correspond to these points. If it is remembered that the problem involves simply the transfer of a line from a drawing to a ship and the setting up of a boring bar in that line, a suitable mode of practical operation should be found without serious difficulty.

Regarding the installation of the engine there is no necessary order of parts which must be followed as a hard and fast rule. Very generally the engine-room auxiliaries should go in first, so as to make sure that no difficulty will be experienced in getting them in after the engines are placed. Then, naturally, the bed plate and crank shaft come first, then the columns, next the cylinders, and then the various other parts as may be convenient. Very commonly the shafting should all be installed before the columns and cylinders are set up, in order to have plenty of room for handling long and awkward pieces down through the engine hatchway. Here again common-sense is worth more than any amount of academic discussion, and the practical man who knows what a marine engine is and how it looks when set up in a ship will not be troubled over the order in which he should take the various parts.

(3) The question as framed seems to refer to a simple engine and to the admission of steam at 100 pounds gage pressure to the cylinder with dimensions as stated. With cut-off at half stroke the expansion, including the effect of clearance, will be found as follows: Assume the clearance 12 per cent.—and it can scarcely be less in ordinary marine practice—then the total volume at the

end of the stroke will be cylinder plus clearance, and this will be represented by 1.12. Similarly the total volume at cut-off will be one-half cylinder plus clearance, and this will be represented by .62. The quotient of these will be 1.806, and this will be the expansion ratio. Then the mean forward pressure will be found by the formula:

$$p = p_1\left(\frac{1 + \text{hyp. log. } r}{r}\right)$$

where p_1 is the absolute pressure at the engine and r is the number of expansions. From a table of hyperbolic logarithms we find in this case:

$$p = 115\left(\frac{1 + .59}{1.806}\right) = 101.2.$$

If then we assume that this is a condensing engine the back pressure may be taken at 3 pounds. This will leave 98.2 as the mean effective pressure, with no allowance for the rounding off of corners, loss by compression, etc. The extent of this loss can only be estimated, but in a single cylinder it should not exceed 10 or 15 per cent. This would give as the mean effective pressure from 83 to 88 pounds with a *condensing* engine and under the conditions specified.

This computation gives simply an estimate of the probable mean effective pressure. The indicator alone can give the actual value. It may be noted that the conditions assumed in this question as it is worded are not met with in marine practice with engines of this size.

In the latter part of the question it seems to be assumed that the amount of the steam is measured by the mean effective pressure. This is entirely erroneous. The only way in which the question can be answered is to find the amount required to fill the cylinder once up to the point of cut-off. To this end we find the volume, which is 58,905 cubic inches. At 100 pounds gage pressure the relative volumes of water and steam are as 1 to 241. Hence the corresponding volume of water will be 58,905 ÷ 241 = 244 cubic inches, or about 8.8 pounds. This would be the amount were there no cylinder condensation. Actually a part of the steam would be condensed as it enters the cylinder and comes in contact with the relatively cooler surfaces. In such a case as that here assumed the amount thus condensed might readily be 20 or 30 per cent. of the whole, and we should therefore expect that not less than 10 or 11 pounds per stroke or 20 to 22 pounds per revolution would be required to supply the engine in question.

Towing on Erie Canal.—The subject of towing by electricity on the Erie canal has again been brought up in view of the successful experiments in this line in Belgium and in other countries. There are several systems of towing, and that which seems to be best adapted for canal purposes, where the speed of the boat is largely limited by the wash and waves made, is that of an overhead trolley cable. The motor runs on a cable directly over the canal and is supplied with electricity from a second wire. Another system is that of having a traction engine running along the towpath and operated by electricity received from an overhead trolley.

TECHNICAL PUBLICATIONS.

The Resistance and Power of Steamships. By W. H. Atherton and A. L. Mellanby. Size 5 by 7 inches. Pp. 196, with numerous cuts and diagrams. Technical Publishing Company, Manchester, England. Price five shillings.

The subject matter of this book appeared first in the form of occasional articles published in *The Practical Engineer* and written chiefly by the first-named author. The various recognized methods of determining the engine power required to propel steamships are discussed in detail, and examples of their application are given. The subject of fouling is also discussed in detail, on account of its important influence on the actual resistance of seagoing ships. The purpose of the authors has been to present this general subject matter in such manner as will appeal to marine engineers and shipbuilders, and to those in general who are interested in the development of modern marine construction.

The work in general seems to have been carefully done, and, in accordance with the apparent purpose of the authors, consists in a compilation and presentation of the various methods which they may have deemed of interest or value. The authors have not always been able to escape the influence of a great name or of fashion in the past. Thus Rankine's augmented surface method is given with all the minutiæ which might have been considered appropriate forty years ago, and as though the augmented surface when computed were of some particular value, or the theory on which its application was based were of some present-day use. Similarly, Scott-Russell's rules for the length of fore body and after body are given as though they might be followed at the present day. As a further instance of this, mention may be made of Kirk's analysis, and of the value of the wetted surface which thereby results. It is well known that as a method of computing wetted surface this method of using a substituted block is quite inaccurate, and is distinctly inferior to several empirical formulæ vastly simpler and quicker in application. As a method of aiding in comparing ships the block models may have a use, but not advantageously for the computation of wetted surface. The name and justly high reputation of Dr. Kirk have led his followers to give to these methods more importance than their author would probably have been inclined to give himself.

In an historical discussion of the development of ideas regarding ship resistance and power, all such methods should find their full explanation. In a presentation of the best and latest word of modern research on these matters, however, an author is hampered by sticking too closely to the historical landmarks.

The treatment of the law of comparison is clear on the whole, but a more definite statement of its foundation and real significance would have been useful. The Admiralty formula is discussed and its relation to the law of comparison brought out. This discussion, as a whole, is scattered through parts of different chapters, and a more unified treatment would have put the matter in a form somewhat more readily grasped.

The matter relating to fouling and the consequent increase of resistance forms one of the most interesting

sections of the book, and is the more acceptable as such matters are not commonly treated with so great detail under the general subject title of the book.

As a whole the book will prove of interest and value in a simple and practical way to many who have to deal with problems of ship resistance and powering. It will be of but small value, however, to those who may wish to acquire any really thorough understanding of the topics considered, especially in their wider aspects and independent of the particular problems with which they may be associated.

The Gas Engine Handbook. By E. W. Roberts, M.E. Fourth edition. Size 3 1-2 by 5 inches. Pp. 264, with numerous illustrations. Gas Engine Publishing Company, Cincinnati. Price $1.50.

This little handbook, published first in 1900, has met with such success that it has rapidly passed through successive editions. In the preface to the present and fourth edition the author calls attention to the additional matter on automobile engine design, on the power factor as a means of comparing the performances of gas engines. on the two-cycle type of engine, and on screw propellers for small boats. On the latter topic the methods given can hardly be considered satisfactory for propeller design. The statement is made that for large vessels the pitch of the propeller is usually 1.3 times the diameter, while for smaller craft the ratio is from 1.6 to 1.8, and that a propeller 30 inches diameter is usually given a pitch of 51 inches.

It is true that for large ships, and smaller ones, too, for that matter, the pitch ratio is often in the neighborhood of 1.3. The idea should not be gained, however, that there is anything binding in regards this ratio. As a matter of fact the pitch ratios of large propellers are found from 1.0 to 1.5, and naturally many will be found about 1.3, which is near the middle of the range.

For small boats the pitch ratio is often found from 1.3 to 1.8 or more, depending largely on the desired speed and revolutions of the engine. With electric launches, however, the pitch ratio is very small, usually about 1, or less. The pitch ratio should not be selected independently in the manner suggested, but should result from a proper relation between the desired speed, power, and other conditions of operation.

For determining the diameter of the propeller the rule given provides for a disk area 40 per cent. of the immersed midship section of the boat. This will give fair results if experience is available for determining the other features. For high-powered boats, however, the ratio should be somewhat higher. This topic is, however, only incidental to the main purpose of the book. With the general subject of gas engines, their design, construction, and operation, the author is thoroughly at home, and is an acknowledged expert in this general field of engineering work. The book covers the field of modern gas-engine design and construction, more especially as utilized for motor boats and vehicles, and in a clear and instructive style. The additional matter on automobile practice should be very acceptable to those interested in this field of application for the gas engine, and in its latest revision the book will deserve and doubtless receive a continuance of the high favor which has attended its appearance in earlier editions.

The Shipbuilding Industry in Germany and in Other Countries. By Tjard Schwarz and Dr. Ernst von Halle. Vols. I. and II. Size 7 by 10 inches, pp. 604, with charts and folding plates. Berlin, Ernst Siegfried Mittler and Sohn. Price 20 marks.

In 1899 a German government commission was ordered to make a careful examination of the development of facilities for shipbuilding in the various German shipyards. The scope of this examination was later extended to cover the chief maritime countries outside of Germany. This research gave such a rich store of materials as to justify the publication of such parts as might prove of especial interest or value to the industrial world. The authors of the present work were therefore entrusted with the editing and preparation of the matter for such publication, and we have the result in the two volumes under notice.

The first volume deals more especially with shipbuilding in countries other than Germany, and the second with the condition of the art in Germany.

The titles of some of the more important chapters will serve to show the scope and character of treatment. Such are: The technical development of shipbuilding in the nineteenth century; the numerical development of the world's merchant fleet since 1815; the principal legislation relative to shipbuilding in the nineteenth century; the development and organization of the chief shipyards in England, America, France, and Germany; ship classification societies; quality of the materials of construction for ships and marine machinery; establishments for model experiments; the principal educational establishments where instruction in marine construction is given; historical development of German shipbuilding; detailed organization of the chief shipbuilding yards in Germany.

Taken as a whole, this work is of the greatest value and interest as the first comprehensive view of the world's shipbuilding industry which has appeared since the art took on its modern form. The members of the commission, among whom were the authors, enjoyed the widest opportunities for gathering material for such a work, and with characteristic national thoroughness they have made the most of their opportunities. From this mass of material the authors have made wise selection, and give a view of the present condition of the art which should prove of the highest value to all who are concerned with ships and shipping. It is to be regretted that no translation into English has been made, so that the usefulness of the work might be more readily extended in the United States and Great Britain.

Life and Adventures of "Jack" Philip, Rear-Admiral, U. S. N. By Edgar S. Maclay, A.M., and Barrett Philip. In 4 volumes. Price 25 cents each. Size 7 by 10 inches. First volume pp. 80, with 6 illustrations. The Illustrated Navy, 13 Astor place, New York, N. Y.

The first volume of the life and adventures of "Jack" Philip has been published in the form of a magazine, and will include four numbers. The introduction is written by Captain A. T. Mahan, U.S.N., and Rear-Admiral Balch, U.S.N., and Mrs. Mary Philip Wheelock, sister of Admiral Philip, have also contributed articles. The story of Captain Philip's life is written by Edgar S. Maclay, A.M., and is interspersed with extracts from Captain Philip's diary. Few officers in the United States navy have had a career so nearly ideal as that of Captain Philip. His

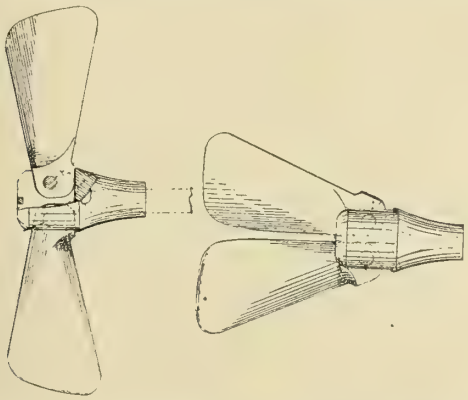
long devotion to duty, his conscientious carrying on of routine, his superb conduct in battle, modesty, generosity, and splendid character, have more than endeared him to the American people. After the untimely death of Rear-Admiral Philip, known as "Jack" Philip by all of those close to him, it was found that he left practically nothing to support his family, and his friends have taken this means of raising funds. The first number of the magazine is indeed attractive and it is promised by the publishers that the three succeeding numbers will be equally so. All those interested in our navy will appreciate this book, which covers the periods of the Civil War and the reconstruction.

The American Power Boat Association Year Book, 1903. Size 4 1-4 by 5 1-2 inches. Pp. 46. Rudder Publishing Company, 9 Murray street, New York, N. Y. Price 25 cents.

The racing rules, articles of association, time allowance tables, etc., of the American Power Boat Association are given in a compact size pamphlet, and will be found of very great value to owners of power boats. Until this association was recently formed there was no standard of rules for racing power boats. The object of the association, as stated in the articles, shall be to promote the use of power boats and the improvement of their design and power construction, and to formulate rules to cover the trials of speed and endurance between such boats. In following out this worthy object the organizers have well covered the classification of different boats and worked out tables of time allowance for use in rating boats. Under the direction of this organization it is to be hoped that the power-boat races may be systematized and that there will be some uniformity in the general design of such boats.

SELECTED MARINE PATENTS.

725,097. PROPELLER. ARTHUR W. LEARNARD, BOSTON, MASS.



Claim.—1. In a propeller of the character described, a hub or head adapted to be rigidly secured to the shaft; and blades pivotally secured at their inner ends to the hub or head and adapted by their shape to spread or swing outwardly therefrom and act as propeller blades when the shaft is rotated in the ordinary direction, and to fold inward toward each other when the shaft is reversed or the vessel is drawn through the water by sail or other power not connected with the propeller shaft. Four claims.

725,137. AIR-EJECTING APPARATUS FOR VESSELS. GUSTAVE QUANONNE, HOUDENG-GOEGNIES, BELGIUM.

Claim.—1. In a ship, in combination with blowing apparatus designed to facilitate her progress, and with air distributers fed from said apparatus, means for counteracting the outward obstruction of the air outlets, and means for preventing the bursting of the pipes in case of excessive air pressure. Six claims.

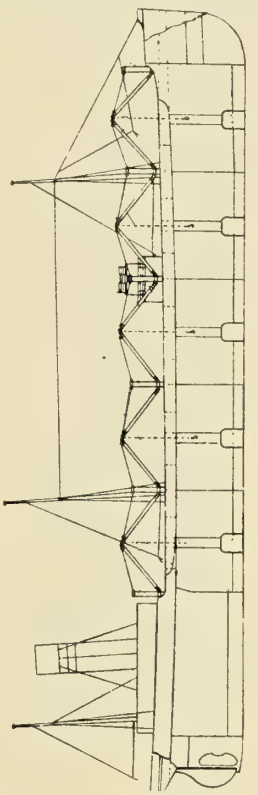
725,202. METHOD OF FORMING NAVIGABLE CHANNELS. LINDON W. BATES, CHICAGO, ILL.

Claim.—1. The herein-described method of forming channels in river bars and the like, which consists in eroding the material of the bar in a groove or channel extending across the entire length of the bar, and keeping the eroded material in suspension, whereby said material will be carried downstream through said groove or channel by the current of the river. Six claims.

725,203. APPARATUS FOR FORMING NAVIGABLE CHANNELS. LINDON W. BATES, CHICAGO, ILL.

Claim.—1. In an apparatus for forming channels in river bars and the like, the combination of a line of flexibly-connected pontoons extending across substantially the entire width of the bar; means for reciprocating said pontoons across the surface of the bar and maintaining them in their various adjusted positions; and eroding devices for the surface of the bar carried by said pontoons. Two claims.

725,219. CARGO-TRANSPORT VESSEL. WILLIAM G. CLARK, WATERLOO, NEAR LIVERPOOL, ENGLAND.



Claim.—1. A cargo-transport vessel having its hull divided into a plurality of holds by athwartship bulkheads; tunnels at the lower part of the holds, and extending transversely therein; vertical shafts extending between the deck above the holds and the upper part of the tunnel; a continuous hatch disposed on either side of the center line of the ship, raised on and standing above same, into which the upper ends of the said shafts enter, and to which they are connected.

2. A cargo-transport vessel having its hull divided into a plurality of holds by athwartship bulkheads; a tunnel at the lower part of the holds, extending across same laterally; a vertical shaft extending from the tunnel up to the deck; and an endless conveyer on the floor of the hold, extending between the interior of said holds and the interior of the tunnel. Six claims.

725,264. FLOAT ARRANGEMENT FOR BOATS. WILHELM M. VON MALEIN, HAMBURG, GERMANY.

Claim.—1. The combination of a boat with a vertical pivot at each side of the boat, an outrigger rotatably mounted on each pivot, and float bodies rotatably mounted in the free ends of the said outriggers. Three claims.

725,280. SHIP'S PROPELLER. GEORGE R. NOBLET, PARADISE, OKLA.

Claim.—1. A propeller comprising a casing having a shaft disposed centrally thereof, a wheel on the shaft having a diameter substantially the same as the casing, and a helical blade secured to the shaft in the rear of the wheel and having its diameter increasing gradually in the direction of its rear end. One claim.

725,399. COMPASS ATTACHMENT. JOHN L. BLISS, NEW YORK, N. Y.

Claim.—1. The combination with the glass plate of a compass box provided with a socket in its upper face, of a compass attachment for determining the compass position of the sun, the said attachment comprising a bracket provided with a projection for entering the socket in the glass plate of the compass box to center the bracket with respect to the compass plate, a thread extending from the base to the head of the bracket, and means for permitting the adjustment of the thread to render it taut. Three claims.

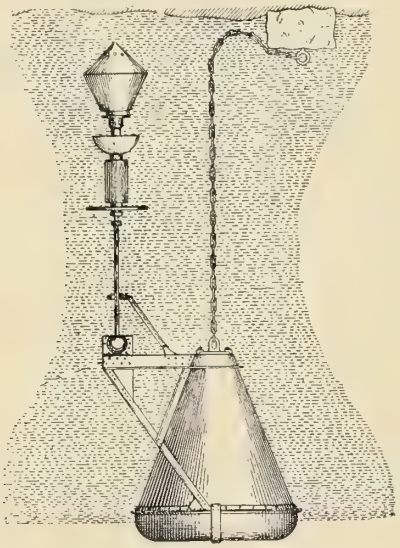
725,570. OBSERVING TUBE FOR SUBMARINE BOATS. SIMON LAKE, BRIDGEPORT, CONN.

Claim.—1. The combination with a submarine boat, of an observing tube passing through the wall of the same and surrounded by a stuffing box by which it is held rigidly in upright position, but is permitted to slide outwardly and inwardly and to be revolved in respect of said boat, a mirror or reflector in the upper or outer end of said tube adapted to receive laterally an image of an external object and to reflect it downwardly through said tube, and means for raising and lowering said tube through its surrounding stuffing box. Two claims.

725,639. PROPELLER WHEEL. CHARLES L. WEBBER, NEENAH, WIS.

Claim.—1. A propeller wheel having a plurality of blades arranged at a suitable angle with its axis around its hub, each blade consisting, upon its side for acting upon the water for propelling a vessel forward, of a flat plate of metal of polygonal form, the contour of its forward or entering edge being of an obtuse angular form, the outer end of the blade being an acute angle which lies in that plane of rotation of the wheel which passes through the shank of the blade, and the rear edge of the blade having a nearly right angle and an obtuse re-entering angle. Six claims.

725,755. AUTOMATIC MEANS FOR PRODUCING SOUND VIBRATIONS IN WATER. ARTHUR J. MUNDY, BOSTON, MASS.



Claim.—1. A submerged automatic sound-producing signaling device for imparting sound vibrations to water by which they are conducted, means operated by the water for actuating the device comprising a buoyant support by which the device is suspended in the water, and an interposed mechanism between it and the sound-producing device whereby a change in the relation of the two produced by movement of the water will cause the sound-producing device to be actuated. Six claims.

725,839. APPARATUS FOR FACILITATING THE SIGHTING OF DISTANT OBJECTS FROM SUBMARINE BOATS, BARBETTES, ETC. HOWARD GRUBB, DUBLIN, IRELAND. Four claims.

725,887. TIDE-WATER APPARATUS. HENRY SMETANA, NEW YORK, N. Y., ASSIGNOR TO INTERNATIONAL TIDE POWER COMPANY, A CORPORATION OF NEW YORK. Three claims.

726,085. SUBMARINE BOAT. HARRY H. MORRELL, NEW SUFFOLK, N. Y.

Claim.—1. A submarine boat having an escape opening directly into the water when the boat is submerged, and local means in the boat for receiving the water passing through the escape, the said means serving to retain the water and thereby form a breathing space adjacent to the escape. Seven claims.

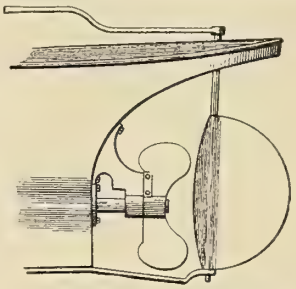
726,118. DEVICE FOR INDICATING POSITION OF SUNKEN SHIPS. ANDREAS TOMIC, PITTSBURG, PA. Two claims.

726,227. SUBMARINE BOAT. SIMON LAKE, BRIDGEPORT, CONN.

Claim.—1. The combination with the hull of a submarine boat, of a normally closed superstructure covering the upper portion of the same, means for admitting water to said superstructure, a discharge pipe extending from the bottom of said superstructure to the top of the same, and provided with a normally open inwardly-closing check valve, and means for admitting air under pressure to said superstructure to expel the water through said discharge pipe.

2. The combination with the hull of a submarine boat, of a normally closed superstructure covering the upper portion of the same, of which the deck is higher along the center than at the edges, means for admitting water to said superstructure, and an air pipe leading outwardly from the higher portion of said superstructure. Two claims.

726,180. WEED CUTTER FOR THE PROPELLERS OF LAUNCHES. LUDVIC M. MILLER, WINNECONNE, WIS.



Claim.—1. In a weed cutter for launches, the combination of a weed guide attached to the hull and provided at its rear with a cutting edge, a screw or propeller having cutting edges which move in close proximity with the cutting edge of the weed guide. Three claims.

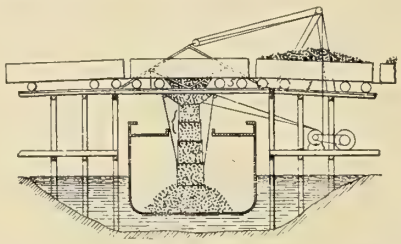
726,268. PILE DRIVER. FREDERICK A. VON EBERSTEIN, SAVANNAH, GA. Three claims.

726,647. MARINE-ENGINE GOVERNOR. PETER V. CORNILS, SEATTLE, WASH.

Claim.—1. A marine-engine governor comprising a compressed-air reservoir, a counterbalancing cylinder containing a piston and connected at one end with the said reservoir, the other end being filled with a liquid, a water-pressure cylinder in the side of the vessel, opening into the water in which the marine vessel is afloat, a piston in the water-pressure cylinder, connected with the piston in the said counterbalancing cylinder, an actuating cylinder containing a piston and connected with the end of the said counterbalancing cylinder containing the liquid, and means connecting the piston in the actuating cylinder with the throttle valve of the engine. Five claims.

726,733. TIDE MOTOR. PATRICK J. NEVINS, HAVERHILL, MASS. Two claims.

726,685. APPARATUS FOR LOADING VESSELS. ELLIOT HOLBROOK, KANSAS CITY, MO.



Claim.—1. In an apparatus for loading vessels, the combination with a fixed track or way, of a movable bridge or platform having a track or way adapted to align with the fixed track or way and to receive a series of coupled cars, a discharge opening intermediate of the ends of the movable bridge, means for moving the bridge or platform into place over a vessel and with the track or way thereon in alignment with the fixed track or way, whereby loaded cars may be run upon the bridge from the fixed track or way and the load discharged in succession directly into the vessel without uncoupling. Five claims.

726,705. SUBMARINE BOAT. SIMON LAKE, BRIDGEPORT, CONN. Six claims.

Government Ships.—It is reported that the only two government ships under construction which are not behind in their assumed percentage of completion are the battleships *Louisiana* and *Connecticut*. The former is being built at Newport News, Va., and the latter at the Brooklyn Navy Yard.

Institution of Naval Architects.—The summer meeting of the Institution of Naval Architects will be held in Ireland during the last week of June. It is proposed to spend the 23d and 24th of June in Belfast and the 25th and 26th in Dublin. Local committees are preparing an interesting programme for members and visitors. Among the works to be visited are those of Messrs. Harland and Wolff and Messrs. Workman and Clark.